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MOBILITY OF THE NORTHERN BOB-WHITE AS INDICATED BY BANDING RETURNS

By PAUL L. ERRINGTON

THE primary objective of the banding work here discussed was the acquisition of accurate information on Wisconsin Bob-white movements, particularly during the winter months. Specific questions, the answers to which were desired, had to do principally with the stability of winter coveys with respect to composition and territory occupancy, and the amount of annual dispersal to be expected in normal quail populations.

Although the files of Professor George Wagner, who has had charge of the general bird-banding activities at the University of Wisconsin, have accumulated data on the Bob-white prior to 1930, it was not until the University's main banding program for the winters and springs of 1930–1931 and 1931–1932 was assigned to Mr. Harry G. Anderson that this species received any special attention. The project was jointly financed and supervised by the University and by the Wisconsin Quail Investigation (established at the University by the Sporting Arms and Ammunition Manufacturers' Institute and the United States Biological Survey), represented respectively by Professor Wagner and myself.

For the most part the banding operations were conducted on an irregular tract of University Farm properties of about a square mile in area. These were located west of Madison, bounded roughly on two out of four sides by a lake, on the third by a residential district of the city, and on the fourth by open suburban and agricultural country.

The quail population dealt with was one that had from 1929 to 1932 held at a fairly stationary level of around a bird per six acres or close to the estimated carrying capacity of the land without directed management. Cover was as a rule of good quality and well distributed; the inherent environmental weakness, as proved incidentally to be a limiting factor over much

of the Wisconsin quail range, seemed a matter of an inadequate or a restricted winter food-supply. All in all, the quail led naturally independent lives; they were subjected to slight human molestation apart from the necessary capture and handling of trapped birds, this being accomplished with no detected losses or serious injuries.

Baiting at the trapping areas was begun about December 1st, when coveys could be assumed to be reasonably well settled in their winter quarters and when the work of the investigators was aided both by tracking snows and by a decreasing availability of the ordinarily staple quail foods. Seldom could the small amounts of scratch feeds used for baiting be regarded as an appreciable supplement to the food upon which the quail subsisted; the baits were kept at the minimum consistent with attractiveness, so the birds would still be compelled to forage for themselves and retain essentially their wild habits. Subsequent to two or three weeks of baiting, traps were put out at strategic places frequented by the birds and were kept running all winter and as late into the spring as the quail continued to be attracted by grain baits.

Traps of the "government sparrow trap" design but with fishnet buffers to prevent imprisoned Bob-whites from scalping themselves on the wire tops gave the most satisfaction, though various other types were tried. United States Biological Survey bands were used.

Altogether, Wagner's records for the areas under discussion show 279 bands used on Bob-whites up to June, 1932. These include 17 for May, 1928, placed mainly by H. Folsom; 17 for April and 5 for May, 1929, mainly by Anderson and John Gundlach; 6 for March and 14 for April, 1930, by Gundlach and Errington. Omitting consideration of repeats from the same locality within a week to a month or so of the initial banding, few data came from these 59 banded birds except in four instances. No. 506,776, banded May 8, 1928, repeated at the same place May 21, 1929; returns were procured on three others, also from the vicinity of where banded. These latter were 506,775, banded May 3, 1928, and returned June 8, 1930, and 352,306, banded April 15, 1929, and 352,313, banded April 13, 1930, both returned July 17, 1930.

Peculiarly enough Anderson, trapping 88 birds in January, February, and March, 1931, failed to recapture a single quail banded during the previous years, nor did G. Stanek, who banded most of 22 new birds for April and May, 1931, find trace of them.

I do not think that this points to a total absence of quail

carrying bands at this time, for it seems unlikely that all of the old birds could have been eliminated in a few months or that outward drift could be completely explanatory. I suspect that the mild and almost snowless winter of 1930–1931 had a pronounced influence on the banding results; the quail population, having a food-supply unusually available, conceivably did not feel the strongest of incentives to turn to the trap baits offered. It appears reasonable that if the quail were not really pressed for food, the bulk of those caught would be the comparatively inexperienced individuals of the season's increase, the banded, more self-sufficient adults being not quite so ready to enter the traps. Experience with English Sparrows and with fur-bearers has impressed upon me a realization that the adults of higher vertebrates are likely to display more shyness toward traps than do juveniles, the exception of chronic "repeaters" notwithstanding. Then, again, the total of annually active banded birds doubtless had been reduced in mathematical significance by normal mortality turnover and possibly by some egress from the area, as an average of only 20 bands per year had been placed since the spring of 1928.

The most spectacular banding feat of the campaign can be credited to Robert Halpin, who caught July 9, 1931, a mother quail (651,185) and her brood of fourteen half-grown young. Three of the brood (A429744–48–51) repeated with the mother at the same place July 25th; another (A429749) was killed by motor traffic about one hundred fifty yards distant on December 5, 1931; and one more (A429750) repeated in the immediate locality February 7, 1932. Nothing further has been heard of this brood.

Far more productive of data was Anderson's second season of intensive quail banding. From December, 1931, to May, 1932, he was responsible for nearly all of the 96 birds banded, and in the course of his work he recorded a substantial number of repeats. Most of these repeats were of birds recaptured within a month or two at or near the place where banded. Indeed, if a winter bird repeated at all within three months it was usually taken at about the same place, although appearances at points a quarter-mile distant were not uncommon.

Some examples of important 1931–1932 repeats at the original banding stations might be listed, illustrative of birds exhibiting attachment for definite territories:

Band	*Date Banded*	*Date Repeated*
649893	Dec. 12, 1931	Jan. 14, April 13, 1932
A429773	Dec. 28, 1931	Jan. 14, 18, Mar. 1, 1932
A418509	Dec. 28, 1931	Mar. 1, 1932
A427767	Dec. 28, 1931	April 13, 1932
A418507	Dec. 28, 1931	Mar. 31, 1932
A418508	Dec. 28, 1931	Jan. 14, Mar. 31, 1932
A429771	Dec. 28, 1931	Mar. 1, 31, 1932
A429772	Dec. 28, 1931	Mar. 31, 1932
A429778	Dec. 28, 1931	Feb. 19, 29, Mar. 31, 1932
651154	Feb. 2, 1931	Feb. 3, 8, 19, May 19, 20, June 23, 27, July 7, 1931
651185	Feb. 8, 1931	July 9, 25, 1931; Feb. 7, 1932
651188	Feb. 19, 1931	July 2, 22, 1931
A427780	Mar. 24, 1931	July 10, 1931
A427748	April 7, 1931	Dec. 15, 28, 1931
A427749	April 14, 1931	Dec. 29, 1931
A427764	May 13, 1931	Dec. 29, 1931

In the above table will be noted 651185, the hen trapped July 9, 1931, with her brood of fourteen. One of the young (A429750) repeated with her on the last date, February 7, 1932.

Examples of 1931–1932 repeats at distances of about a quarter-mile from where banded follow:

Band	*Date Banded*	*Date Repeated*
525358	Jan. 25, 1931	Dec. 28, 1931
651160	Feb. 2, 1931	April 19, 1931 (bird also repeated where banded Feb. 3, 8, April 21, 27, May 2, 1931)
651181	Feb. 2, 1931	April 21, 1931 (repeated where banded Feb. 8, April 21, 22, 1931)
651153	Feb. 2, 1931	Dec. 13, 1931; Feb. 28, 1932
A427741	Mar. 24, 1931	May 14, 1931
646665	April 18, 1931	Feb. 7, 1932
646662	April 18, 1931	Feb. 12, 1932 (repeated where banded May 9, 1931, and nearby April 14,1932)
646666	April 19, 1931	May 26, 1931; Feb. 7, 1932 (repeated where banded May 4, 1931)
646669	April 21, 1931	June 27, July 7, 1931
649892	Dec. 12, 1931	Dec. 29, 1931; Jan. 13, 16, 1932 (repeated where banded Feb. 7, 1932)
649894	Dec. 12, 1931	Feb. 19, 1932 (repeated where banded Dec. 20, 29, 1931)
649895	Dec. 12, 1931	Feb. 19, 1932 (repeated where banded Jan. 4, 1932)
649897	Dec. 12, 1931	Feb. 19, 1932 (repeated where banded Dec. 20, 29, 1931)
649898	Dec. 12, 1931	Feb. 19, 1932 (repeated where banded Dec. 20, 25, 1931; Jan. 13, 1932)

649900	Dec. 12, 1931	Feb. 19, 1932 (repeated where banded Dec. 20, 28, 1931: Jan. 16, 1932)
A427734	Dec. 12, 1931	Feb. 19, 1932 (repeated where banded Dec. 20, 29, 1931)
A427735	Dec. 23, 1931	Dec. 29, 1931: Jan. 8, 1932
A427736	Dec. 23, 1931	Dec. 29, 1931
A427738	Dec. 23, 1931	Dec. 28, 1931: Jan. 17, 1932 (back where banded Feb. 7, 1932)
A427765	Dec. 28, 1931	Feb. 19, 1932 (repeated where banded Jan. 11, 1932)
A418501	Dec. 28, 1931	Feb. 19, 1932
A418504	Dec. 28, 1931	Feb. 7, 1932
A418506	Dec. 28, 1931	Feb. 7, 1932

1931–1932 repeats at a distance of about a half-mile from where banded:

Band	*Date Banded*	*Date Repeated*
443936	Jan. 24, 1931	Dec. 13, 1931
653006	Jan. 24, 1931	Mar. 31, 1932
653009	Jan. 24, 1931	Dec. 28, 1931 (repeated where banded Feb. 2, 8, 1931)
653012	Jan. 24, 1931	Mar. 31, 1932
A427750	April 21, 1931	Feb. 7, 1932
A437806	Feb. 7, 1932	April 13, 1932 (repeated where banded Feb. 13, 1932)

Worthy of separate mention are two particularly ambitious wanderers. No. 427761, banded April 22, 1931, was recaptured April 27th about 1200 yards away, repeated at the latter place May 2d, was taken the same day at still another banding station nearly 900 yards distant, and finally repeated at another trap site, 550 yards from the last, May 7th, 8th, 11th, 12th, 13th, and 14th. The longest move of which I have record was by A427775, banded at the University Hill Farm March 19, 1931, and caught as a repeat February 7, 1932, at a distance of two miles. Neither sex has revealed more propensity than the other to range widely; for the seven quail repeats farthest from original stations, the male-female ratio was 3: 4.

Bands taken from birds collected as specimens or found dead substantiated on the whole data derived from repeats at banding stations. The following constitute the most reliable 1931–1932 returns at hand:

Band	*Date Banded*	*Date Returned*	*Distance from Station*
653008	Jan. 24, 1931	June 19, 1932	Half-mile
651182	Feb. 3, 1931	Fall, 1931	About the same place
651184	Feb. 8, 1931	May 23, 1931	Less than quarter-mile
651187	Feb. 19, 1931	July 16, 1931	Less than quarter-mile
651176	Mar. 10, 1931	Feb. 10, 1932	Less than half-mile
A427760	Mar. 19, 1931	Mar. 30, 1931	Same place
A427757	Mar. 19, 1931	May 17, 1931	Half-mile
A427776	Mar. 19, 1931	June 2, 1931	125 yards
A427771	Mar. 19, 1931	July 10, 1931	Less than half-mile
646664	April 18, 1931	July 16, 1931	About 1000 yards
A429749	July 9, 1931	Dec. 5, 1931	150 yards
A429777	Dec. 28, 1931	Feb. 20, 1932	About same place
A437844	April 13, 1932	June 20, 1932	About 1000 yards

Tabular recapitulation of 1928 to 1932 data on the movements of 125 Bob-whites, totalling 201 repeats and 16 returns:

	Total repeats and returns	*At or near banding station*	*Within 200 yards*	*Within Quarter-mile*	*Within Half-mile*	*Within Two miles*
First month	115	95	6	11	3	
Second month	31	22	5	4		
Third month	23	8		12	4	
Fourth month	12	9	2		1	
Fifth month	6	4	2			
Sixth month	5	5				
Seventh month	1	1				
Eighth month	2	2				
Ninth month	3	3				
Tenth month	4			3	1	
Eleventh month	4		1		2	1
Twelfth month	4	1		2	1	
Thirteenth month	2	1	1			
Fourteenth month.						
Fifteenth month	2				2	
Sixteenth month	2		1		1	

The lack of repeats for the sixth to ninth months at distances away from the station is doubtless due to the fact that no trapping on any extensive scale was carried on during the warmer months; the one or two stations usually working would take banded birds that happened to visit them but would reveal nothing concerning many others that might be in the neighborhood.

On the basis of the assembled data, what conclusions are we entitled to arrive at with respect to the stability of winter coveys? It is apparent that the Bob-white tends to remain for more or less protracted periods of time in relatively small areas. This is especially true of moderate populations well situated as to food and cover during the cold weather months. The Bob-white covey, while determined to be but a unit of convenience and of no fixed number or composition (see Stoddard, The Bob-white Quail, 1931), nevertheless may be said when once settled for the winter to take on a certain definiteness. Now and then birds may leave their coveys or territories and others may come in, but commonly they are reluctant to depart from their seasonal living routine, provided conditions for existence are tolerable. On the basis of field experience, too, I feel fairly able to predict just about what a given covey is likely to do from day to day, though it is by no means to be asserted that covey habits are equally predictable over a space of weeks or months.

Indeed, in terms of year-round behavior and residence, one can speak with increasingly less assurance as to what a quail is going to do or where it is going to be. Granted that the scanty data presented here do not bear it out particularly, it seems evident from field observation that by far the greater proportion of Bob-white territory-shifting not attributable to gross environmental changes (those linked with food and cover) is initiated by restlessness attendant upon the spring sex awakening. The disintegration of coveys preliminary to pairing is followed by the occupancy of rather large tracts of land previously quail-vacant. When the advent of fall draws the miscellaneous juveniles and adults together as coveys, the banding results show that the old birds do not necessarily gravitate back to their former winter coverts.

Furthermore, it appears likely that the redistribution of the adult quail population after the breeding season, within limits of a half or three-quarters mile or even a greater radius, may be to no small degree fortuitous; a bird spending practically the entire winter within a quarter-mile or less of the center of the covey territory may the next season winter in a territory possibly a couple of miles away. In other words an individual Bob-white may continue to live in approximately the same place from year to year, or it may not.

TESTIS ACTIVITY IN *STURNUS VULGARIS* RELATION TO ARTIFICIAL SUNLIGHT AND TO ELECTRIC LIGHTS OF EQUAL HEAT AND LUMINOUS INTENSITIES.[1]

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INTRODUCTION

IN previous studies of the effects of electric lights used to prolong the daily periods of light for *Sturnus vulgaris*, and, particularly, of that from the "sunlamp" of the General Electric Company in relation to light of restricted wave-length and from other sources, it was noticed that the luminous intensity of the "sunlamp" closely approximated that of a 200-watt incandescent bulb. On the other hand, its "heat" intensity, as measured by a thermopile and galvanometer with variable resistance, at the distances used, was of the order of that from a 1000-watt bulb similarly used. (Bissonnette, 1930a, b, 1931a, b, 1932a, b, c, d, e; Bissonnette and Chapnick, 1930; Bissonnette and Wadlund, 1931, 1932).

These previous studies indicated that the effects on testis activity in Starlings (*Sturnus vulgaris*) of filtered red, filtered green, and unfiltered white light from incandescent bulbs were not proportional to the total heat energy reaching the roost on which the birds perched, and around which they circulated in the cages. With equal luminous intensities of lights so used, the heat equivalents were, red, 10; green, 2.5; white, 1; and controls, 0; while the relative amounts of stimulation of testis activity were in the descending order, red, white, control, green.

These findings suggested that it would be well to determine the relative effects, in this connection, of ordinary incandescent lights of equal luminous intensity and of equal "heat" intensity, as compared with the "sunlamp", with its content of ultra-violet and its somewhat different spectrum (Bissonnette and Wadlund, 1932). As birds of similar known previous light

[1]Studies on the sexual cycle in birds. IX. Aided by grants from the Committee for Research in Problems of Sex and the Grants-in-Aid Committee of the National Research Council of the United States, 1930-1932, administered by T. H. Bissonnette, and by laboratory and library facilities of the School of Agriculture and Zoology Laboratories, Cambridge, England, for which the authors wish to express thanks.

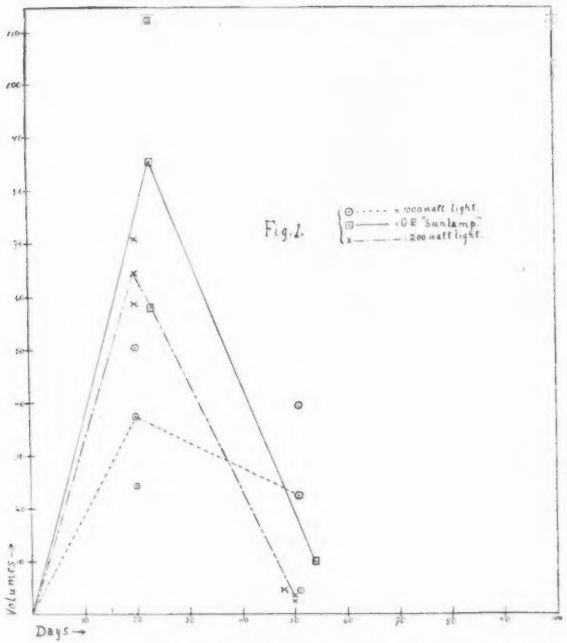

Figure 1. Graphs of changes in testis volumes of "1000 watt," "sunlamp," and "200 watt" birds.

history were available, the effects on three different cages of birds were tested, with the "sunlamp" acting on one cage, an incandescent bulb at equal luminous intensity on a second cage, and another incandescent bulb at equal "heat" intensity acting on a third cage.

The results proved very interesting and were consistent with those from previous experiments and with the conclusions drawn from them.

Material and Method

Between March 25 and June 11, 1931, three cages of birds previously kept as controls, on a restricted "light ration"[2] of

[2]Throughout this paper "light ration" is used to denote time × intensity of daily illumination and type of rays used for artificial lighting, *i.e.*, "sunlamp" or ordinary light from incandescent bulbs.

nine and one half hours of daylight per day in a basement room (Bissonnette and Wadlund, 1932), were taken for experiments. Conditions of their testes at the beginning of the experiment are shown in the preceding paper of this series (Bissonnette and Wadlund, 1932, fig. 18, Table I), with their average total testis volume per bird (about 5 cu. mm). No inside controls were kept for comparison with these three sets of birds, because the available birds, with controlled previous light history, were few in number and the reduced "light ration" was known to keep birds indefinitely in winter testis condition (Bissonnette, 1931a, and subsequent studies).

Light from a General Electric Company's "sunlamp", with reflector, was thrown laterally into one cage, hereinafter called the "sunlamp" cage, from a distance of 24 inches from the center of the roost, giving 80 lumens per square foot at the roost. Into another cage, the "200-watt" cage, light from a 200-watt clear lamp, with reflector, was thrown in the same way from 36 inches distance, also giving 80 lumens per square foot at the roost. The candle-power of the "sunlamp" was determined as previously described (Bissonnette and Wadlund, 1932), and that of the 200-watt bulb was determined by comparison with the "sunlamp", on the same apparatus. The total "heat" intensity at the roost from the "sunlamp" was then determined by a thermopile-galvanometer apparatus, with variable resistance, as described. Then into a third cage, the "1000-watt" cage, light from a 1000-watt incandescent bulb, with reflector, was thrown in the same way, from such a distance that the deflection of the galvanometer, with the same arrangement of apparatus as for the "sunlamp", was the same. The lights were fixed at these distances throughout the experiment.

Diets were similar to those used in previous experiments and were rich in proteins, fats, and vitamins, to prevent interference, of deficiency in these respects, with the sexual activities of the birds.

The "sunlamp" was turned on for three evenings from March 25th–28th before the other lamps were used, owing to a misunderstanding between the authors. Ten days were allowed to elapse after these three days before the experiment began in earnest, to let the effects of these three days moderate. For this reason "sunlamp" birds were illuminated for three days longer than were the others, when killed on the same dates. This is recorded in Table I. Owing to the small numbers of birds available, it was not possible to discard these birds owing to their "false start". Just what were the effects of the elapsed

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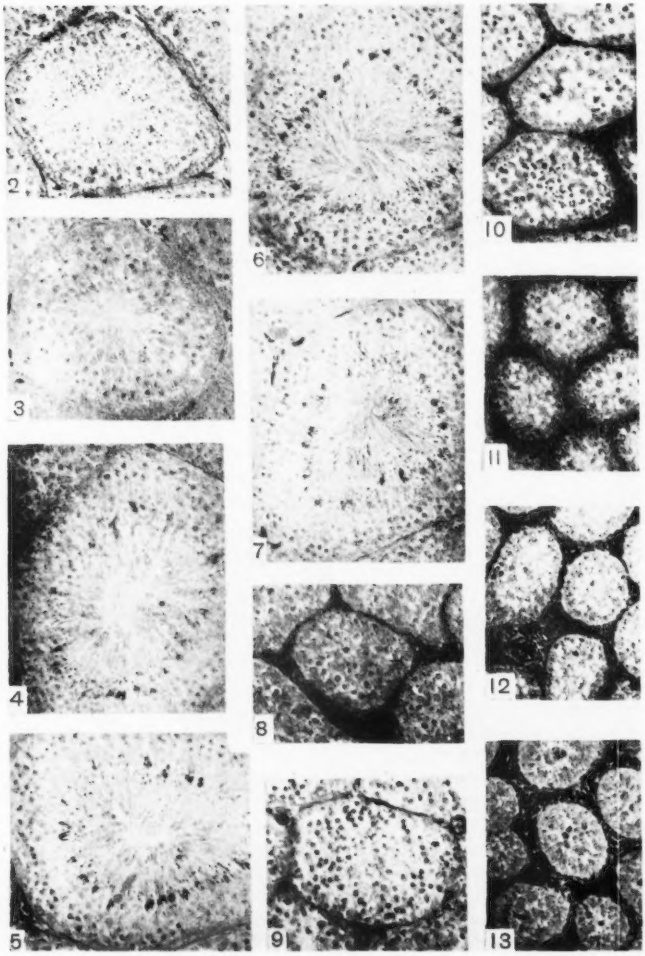

Figures 2–13. Photomicrographs of sections from testes taken at 335. diameters in all cases and reduced to about 170 diameters, in reproduction.

ten days, in modifying the results of the experiment, cannot be judged with certainty as yet.

Comparison of graphs of testis-volume changes with germ-cell changes leads to the conclusion that histological changes and conditions are more characteristically and reliably correlated with "light ration" changes than are testis-volume changes (Table I, Plate figures 1–13, and text figure 1). Table I gives condensed data on the testes of birds killed for study after 20, 23, 48, 51, and 54 days of light treatments.

All three lights were turned on the six hours per night by an electric time switch after a nine-and-a-half hour daily daylight period, as in previous studies. Deaths during the experiment were three in number, and all birds were anæmic toward the end and had the small feathers drop out round the base of the bill, the eyes, and the throat. This was not due to wearing off against the cage, but was probably due to reaction to privation of some sort, such as lack of some types of wave-length of light while being kept as controls behind glass from January 20th till May and June. Their intestines were light-colored and their bills long and pale in color. "Sunlamp" birds were like the others in these respects, indicating that light from such a source did not induce recovery in the time during which it was acting upon them. Juvenile characteristics of bill and plumage disappeared in all birds before they were killed, except in one female.

General Results

The 200-watt incandescent lamp proved most rapidly effective; the "sunlamp" slightly less so; and the 1000-watt lamp, least so. In 20 days, the 200-watt lamp caused the testes to reach and pass their climax of activity, and, probably, of size (Plate I, figs. 6, 7; text—fig. 1). In 23 days of action (3 days before a break of 10 days without added light, and 20 days of light treatments following it), the "sunlamp" caused testes to reach almost their climax (figs. 4, 5, Plate I). In 20 days, the 1000-watt lamp induced much less advanced stages in the testes of the birds exposed to its light. No stages beyond a few metamorphosing spermatids and very early sperms were induced by this lamp with its much more intense luminosity than those of the other two lamps (plate- figs. 2, 3).

In 51 days, the testes of "1000-watt" birds passed over into regression (plate-figs. 8, 9); but did not proceed so far as did those of "sunlamp" birds in 54 days (plate-fig. 10). Their regression was apparently less rapid or began later than that of the "sunlamp" birds. Disorganization was less pronounced. Testes of "200-watt" birds, in 48 days (plate-fig. 11) and in 50

TABLE 1.—DATA RELATING TO BIRDS KILLED AT VARIOUS PERIODS OF LIGHT TREATMENT

Days in Light	*Type of Light*	*Testis size right and left, in millimeters*	*Total testis volume in cu. millimeters*	*Serial No.*	*Figures in Plates*	*Histological and other testis data per bird*
20	1000-watt	R.— 8.4 × 5.5 L.— 8.9 × 5.0	227.4	D. 2	Fig. 3	All germ-cell stages up to spermatids; no metamorphosing sperms yet; interstitial cells not recognizable; pigment scattered.
20	1000-watt	R.— 9.5 × 7.6 L.— 9.8 × 6.8	524.8	D. 1	Fig. 2	Metamorphosing sperms just appearing; tubules about 5/7 maximum diameter; otherwise as above.
23	"Sunlamp"	R.—10.8 × 7.4 L.—12.1 × 6.6	586.3	D. 3	Fig. 4	Tubules approaching maximum diameter; sperms almost complete; interstitials not recognizable; pigment scattered.
23	"Sunlamp"	R.—12.2 × 9.1 L.—13.9 × 9.1	1132.0	D. 4	Fig. 5	Tubules almost maximum diameter; sperms mature; germ-cells of all stages very numerous.
20	200-watt	R.—10.6 × 8.0 L.—12.5 × 7.3	703.8	D. 5	Fig. 6	Past climax of activity; sperms mature and numerous; spermatids and secondary spermatocytes disappearing or failing to form; tubules shrinking; sperms free.
20	200-watt	R.—10.5 × 7.4 L.—11.9 × 6.8	589.4	D. 6	Fig. 7	Similar to the above but farther in regression; interstitials not yet recognizable as such; still like connective tissue.
51	1000-watt	R.— 4.6 × 3.1 L.— 5.2 × 3.0	47.7	D. 8	Fig. 8	Far gone in regression; approaching June 8/15th stage in nature; necrosis and phagocytosis of germ-cells; few synizesis stages of growing spermatocytes and spermatogonia present; interstitials rounding up.
51	1000-watt	R.— 8.4 × 7.3 L.—10.0 × 5.6	399.0	D. 9	Fig. 9	Not so far regressed as the above; necrotic nuclei and debris still present; synizesis stages more numerous; no sperms; interstitials not yet recognizable.
54	"Sunlamp"	R.— 5.8 × 4.3 L.— 6.7 × 3.5	100.0	D. 10	Fig. 10	More regressed than the two just above; necrotic cells still present; synizesis stages rarer; fewer normal germ-cells present; farther along than the above two.
48	200-watt	R.— 4.0 × 3.0 L.— 4.1 × 2.9	36.9	D. 11	Fig. 11	Even farther regressed than the preceding; vacuolated Sertoli cell outlines very plain; germ-cells all gone but spermatogonia; interstitials rounded and recognizable.
50	200-watt	R.— 4.0 × 2.6 L.— 4.3 × 2.3	26.2	D. 12	Fig. 12	Two days later; regression still farther along; otherwise like the above; stage of June 15th to August 1st.
50	200-watt	R.— 4.3 × 2.9 L.— 4.5 × 2.3	31.4	D. 13	Fig. 13	Like the preceding; but vacuoles smaller; farther advanced; testis tubules reorganizing into autumn condition; August and September stages of natural cycle.

days (plate-figs. 12, 13), were far in advance of the other two sets of birds' testes, so far as regression is concerned. This was shown by smaller testis size, smaller tubule diameter, and much reduced intratubular tissue (text-fig. 1).

All the birds subjected to any of the three types of experimental "light ration" reached the climax of spermatogenic activity and passed over into regression in different degrees. The optimum light intensity and optimum type of spectrum, so far as colors and wave-lengths of light are concerned, appeared to lie nearer to those of the 200-watt lamp than to those of either of the other two lamps. Light from the 1000-watt lamp was either too intense in luminosity or of less effective proportions of the different wave-lengths than that of the 200-watt lamp. That of the "sunlamp", though of the same luminous intensity, was evidently either weaker in the more effective long wave-lengths (red rays) or stronger in the types of wave-length which are inhibitory to sexual and spermatogenic activity indicated by our previous studies (Bissonnette, 1930a, b, 1931a, b, 1932a, b; Bissonnette and Chapnick, 1930; Bissonnette and Wadlund, 1931, 1932).

DISCUSSION

The results outlined above are taken to indicate that, (1), ordinary electric light from incandescent lamps of the luminous intensity of 80 lumens per square foot at the roost is more effective as a testis-activator than the same luminous intensity of artificial midsummer sunlight as emitted by the "sunlamp", with its less restricted spectrum and different proportions of the various wave-lengths (Bissonnette and Wadlund, 1932); (2), light from a 1000-watt incandescent lamp is either of too great luminous intensity, if used at the proper distance to give the "heat" equivalent of the "sunlamp", or has a proportion and distribution of its wave-lengths less stimulating as a whole than those of the 200-watt lamp used; it is probably above the optimum in luminous intensity.

This raises the question as to just what constitute the optimum luminous intensity and proportions of the various wave-lengths of incandescent light, used as activators of testis activity. This is being studied from various angles. Our recent studies suggest the probability that monochromatic light of a rather restricted region of the spectrum, in the long-waved end (red), is almost if not entirely responsible for the activation of the sex-glands in Starlings (Bissonnette, 1932b; Bissonnette and Wadlund, 1931, 1932).

These studies showed that red light, with its long waves, was

potent in this respect, while green light, with its shorter waves, but of equal luminous intensity and acting for the same daily periods, was not only ineffective but inhibitory. Violet light, in the much less intensity so far available for use, did not prove stimulating but was probably inhibitory. Hill and Parkes (1931), working with ferrets during the long winter anœstrum, found that ultra-violet, of the range of wave-lengths used, did not stimulate these animals to œstrous activity, when used for five minutes daily for ten days in November, and were led to the conclusion that light was, at most, a very minor factor in sexual periodicity. Bissonnette, however, working on the same animal, found that visible light, from 200-watt incandescent lamps, did induce œstrum in female ferrets in about six weeks in the period from October to February, leading to copulations in December and February, with light-stimulated males from the same room. The males, however, did not produce sperms, though both the germ-cells and the interstitial cells were stimulated somewhat, leading to increased libido and copulations and to the breeding condition of the epididymis. These midwinter copulations led to pseudo-pregnancies in all cases, with all the changes in the female sexual and mammary systems normal to such pseudo-pregnancy, as described by Marshall (1904) and Hammond and Marshall (1930); (Bissonnette, 1932c). These studies suggest that differences in the proportions of the different wave-lengths of visible electric light give differences in amounts of stimulation of sexual activity, leading to sexual periodicity in some birds and mammals, though probably not in all, or not to the same extent in all.

This study lends support to our conclusions from previous studies that "heat" intensity of the incident light is not as great a factor in conditioning sexual periodicity in these birds as are either luminous intensity or wave-length. An optimum wave-length and an optimum intensity are indicated.

A somewhat similar stituation with regard to some of the vitamins has been suggested. An optimum wave-length in the ultra-violet for the activation of ergosterol to give vitamin D has been indicated, with all other wave-lengths, not only not effective, but actually causing reversal of the process, or a change in physical characteristics of the solution containing the vitamin D or the pro-vitamin in the ergosterol; though the matter seems to be still in the controversial stages of the investigations (Bowden and Snow, 1932a, b; Heilbron and Morton, 1932; Morton and Heilbron, 1928, and others).

Some such very limited band of wave-lengths in the visible part of the spectrum may, possibly, be the only effective light region for activation of sex-gland activity. Other cases of

differences in reaction to different wave-lengths of light have been discussed in previous papers and will not be gone over again (Bissonnette, 1931b, 1932b; Bissonnette and Wadlund, 1931, 1932). It is enough to state that phenomena of specificity of definitely limited regions of the spectrum, if not of strictly monochromatic light, are, apparently, widespread in Nature and this is merely one of its many manifestations.

That the anterior lobe of the hypophysis (and possibly the adrenals) probably mediates this light-induced sexual periodicity has been suggested elsewhere (Bissonnette, 1932c, d.).

That even human beings are susceptible to modification of sexual cycles and activity, by changes in periods of exposure to light, and possibly to changes in intensity and wave-length, as well as some birds, and ferrets and voles (Baker and Ranson, 1932) among mammals, is indicated by the loss of sexual activity, libido, and menstruation by Eskimo men and women during the long arctic night and by a similar reaction on the part of the members of the Peary polar exploration party of 1894, cited by Llewellyn (1932).

SUMMARY

(1) A study was made of the relative effects on testis activity in Starlings of lights from (a) a "sunlamp" with visible and some ultra-violet radiations, (b) an incandescent lamp giving equal luminous intensity, (c) an incandescent lamp of greater luminous intensity giving equal total "heat" intensity.

(2) Birds were exposed to these three lamps for equal periods after dark and killed at stated times for study of their effects.

(3) Of the lights used, the descending order of effectiveness as testis-activators was (b), (a), (c); and, as in previous studies, testes of birds, under all three types of light exposure, passed the climax of activity and underwent regression long before 48 days of treatment.

(4) The results are taken to indicate an optimum luminous intensity of light, nearer that from the (b) lamp than that from the (c) one which is evidently above the optimum; that the combination of wave-lengths emitted by the (b) lamp used is more effective than that of the "sunlamp" (a), possibly on account of its probable greater content of long-waved red rays or its smaller content of inhibitory wave-lengths.

(5) The possibility of the specificity of a very restricted region of the visible spectrum, somewhere in the red, for sexual activating powers, and the ineffectiveness of wave-lengths from other regions are discussed.

(6) Instances of such cases of sexual photoperiodicity among

mammals and even in man are cited and their bearings on the general problem of sexual photoperiodicity are discussed.

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LEGENDS

FIG. 1. Graphs of testis-volume changes in birds subjected to illumination after dark by 1000-watt and 200-watt incandescent bulbs at distances required to give the heat equivalent and the luminous equivalent respectively of a "sunlamp" at 24 inches distance, as compared with volume changes in birds lighted by the "sunlamp" at that distance. In the graphs one unit of volume is equal to twice the testis volume of similar birds at the beginning of the experiments.

PLATE I.

N. B.—Figures in the plate are photomicrographs of testis sections taken at 335 diameters in all cases and reduced to about 223 diameters.

FIG. 2. Tubules from bird subjected to light from 1000-watt bulb for 20 days. D1.

FIG. 3. Tubules from a bird subjected to light from a 1000-watt bulb for 20 days. D2.

FIG. 4. Tubules from a bird subjected to light from a "sunlamp" for 23 days. D3. Total "heat" of this lamp reaching the birds was equal to that reaching the birds furnishing sections for figures 2, 3.

FIG. 5. Tubules from a bird subjected to light from a "sunlamp" for 23 days. D4.

FIG. 6. Tubules from a bird subjected to light from a 200-watt bulb for 20 days. D5. Light intensity reaching this and the bird for figure 7 was equal to that from the "sunlamp" reaching birds furnishing sections for figures 4, 5.

FIG. 7. Tubules from a bird subjected to light from a 200-watt bulb for 20 days. D6.

FIG. 8. Tubules from bird subjected to light from a 1000-watt bulb for 51 days. D8.

FIG. 9. Tubules from a bird subjected to light from a 1000-watt bulb for 51 days. D9.

FIG. 10. Tubules from a bird subjected to light from a "sunlamp" for 54 days. D10.

FIG. 11. Tubules from a bird subjected to light from a 200-watt bulb for 48 days. D11.

FIG. 12. Tubules from a bird subjected to light from a 200-watt bulb for 50 days. D12.

FIG. 13. Tubules from a bird subjected to light from a 200-watt bulb for 50 days. D13.

STATE DISTRIBUTION OF RETURNS FROM BANDED DUCKS

SECOND PAPER—BRITISH COLUMBIA, CALIFORNIA, CONNECTICUT, GEORGIA, ILLINOIS, IOWA, AND KANSAS[1]

BY FREDERICK C. LINCOLN

THE purpose of this series of short papers is to acquaint students of birds, sportsmen, conservation officials, and others with the information relative to our migratory waterfowl that is being accumulated by the Biological Survey, through application of the banding method. A complete discussion of the data would demand much more space than is now available, although it is planned eventually to prepare detailed migration reports for the various species.

On the maps now presented, the figures represent the total returns or recovery records for all species. The status of each species is indicated in the accompanying statement. The circumscribed areas represent the point or points of banding, and from these lines lead to the different States or Provinces where the banded ducks have been recovered. The terminals of these lines do not show the exact points of recovery, but merely indicate the number of return records that have been received from those States or Provinces. The number of local returns, that is, the number obtained from the State or Province in which the banding was done, is shown either within the circumscribed area or at the end of a short line therefrom.

The distribution of returns from Alberta was presented in a previous paper. In the present account similar treatment is accorded the data from British Columbia, California, Connecticut, Georgia, Illinois, Iowa, and Kansas.

BRITISH COLUMBIA

About 1850 ducks have been banded in British Columbia. The work was started in the autumn of 1923 when D. W. Gillingham banded a few Pintails and Green-winged Teals at Zone Island in the Fraser River delta. In the spring of 1924, and again in 1925, J. A. Munro and J. G. Cunningham banded a few more Pintails and others at several points in the southwestern part of the Province.

Extensive banding operations were not undertaken, however,

[1]First Paper; Bird-Banding, Vol. 3, pp. 140–142, Oct., 1932.

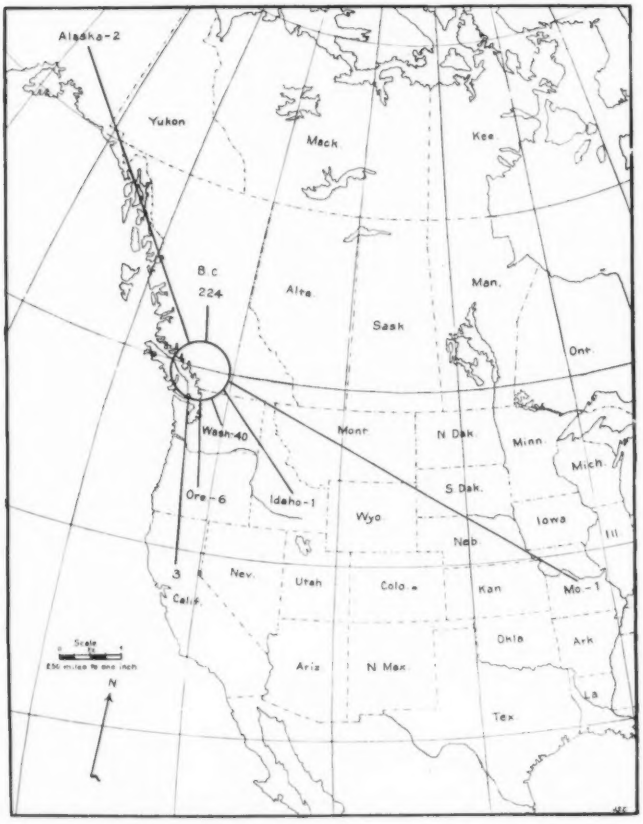

Figure 1. Distribution of Return Records from Ducks Banded in British Columbia.

until the fall and winter of 1928–29, when Constable R. M. Stewart, of the Provincial Police, conducted a station at Chilliwack,[2] in the southwestern part of the Province. During that season 657 birds were banded, mostly Mallards, with a few Pintails and Green-winged Teals. In 1930 this station was operated by Edward Lovell, who banded 474 birds (Mallards,

[2]Constable Stewart is now stationed at Atlin, in the northwestern part of the Province.

with one each of the Baldpate, Green-winged Teal, and Shoveller). A. J. Butler carried on work at this point in 1931, banding 528 ducks. Mallards again constituted the majority of the "catch", but it included also 9 Baldpates, 72 Green-winged Teals, 4 Pintails, 1 Shoveller, and 1 Wood Duck.

Late in the summer and early in the autumn of 1929, F.R. Butler, Secretary of the Game Conservation Board, banded about 50 Mallards at Victoria; and at Vaseaux Lake, in the autumn of 1931, S. J. Darcus banded 130 Mallards, Green-winged Teals, and Pintails, and one Barrow's Golden-eye.

The return records obtained from these operations consist of 254 for the Mallard, 18 for the Pintail, 4 for the Green-winged Teal, and 1 for the Baldpate.

The situation illustrated on the map (Fig. 1), namely that of extreme localization, is peculiar to the Mallard on the northwestern coast, and is paralleled to a certain extent by the Black Duck on the northeastern coast. In some winters Mallards are abundant as far north as southern Alaska. It is particularly noteworthy that no Mallards banded in British Columbia have thus far been recovered in California; the three returns from that State are Pintails. Nevertheless, the long-range return from Missouri and one of those from Alaska, are for this species. The other Alaskan record is for a Pintail.

The evidence here presented seems to justify the conclusion that southern British Columbia and Washington constitute the winter grounds of this group of birds, which probably breed north through British Columbia to Alaska.

CALIFORNIA

Large-scale banding of migratory waterfowl in California was started in February, 1926, when E. W. Ehmann, of Piedmont, recognized the possibilities that existed at Lake Merritt in the city of Oakland, where for many years wild ducks have been protected and fed by the Board of Park Commissioners. These officials generously coöperated, and every year since a large number of the birds have been trapped and banded. The banding work has in no way affected the value of this area as a refuge. More than 4000 birds have been banded at Lake Merritt. Most of these were Pintails, although a fair number were Baldpates. A few Mallards and Shovellers, 1 European Widgeon, 2 Brant, 5 Snow Geese, and a large number of Coots make up the balance.

Through the interest of A. D. Trempe, of Sault St. Marie, Michigan, banding operations were begun in the vicinity of Gustine, in February, 1928, and extended to another station at Irvington in January, 1929. Associated with Mr. Trempe have

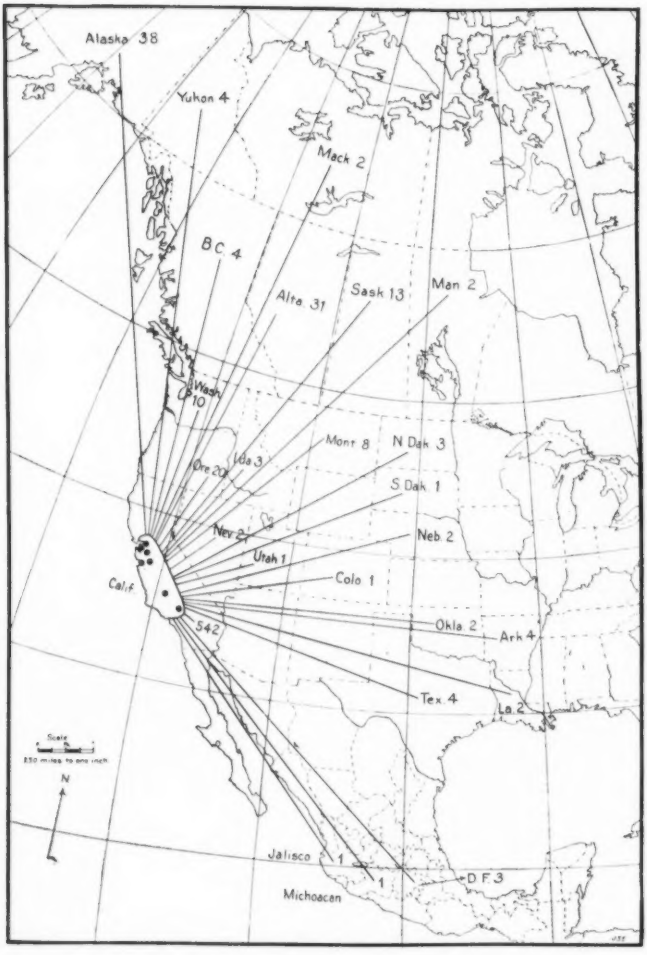

Figure 2. Distribution of Return Records from Ducks Banded in California.

been O. M. Thompson (Gustine), and Nion R. Tucker and J. O. Tobin (Irvington). These stations have banded about 2000 birds, and here also, the majority were Pintails, with many Coots and smaller numbers of Mallards, Baldpates, and Green-winged and Cinnamon Teals, and a few each of the Shoveller, Lesser Snow Goose, White-fronted Goose, and Black Brant.

L. Arnold and L. R. Ainsworth of the State Fish and Game Commission, banded 460 Pintails, 8 Green-winged Teals, 5 Baldpates, 2 Gadwalls, and 1 Shoveller at Buena Vista Lake in February, 1928. During the spring and autumn of 1929, A. A. Oliver banded 28 Pintails and Green-winged Teals at Eden. A large number of Coots also were marked at this time.

United States Game Protector George Tonkin, with headquarters at Berkeley, has taken continuous interest in the banding work and has carried bands as a part of his regular equipment. Although unable to operate a trapping station, he has been instrumental in banding 493 ducks, chiefly hand-reared Mallards released by the Fish and Game Commission at Watsonville and Pittsburg. In addition, he has banded many Cinnamon and Green-winged Teals, Pintails, Canvas-backs, Redheads, and Coots obtained on their breeding grounds, principally in Merced County.

The total number of ducks banded in this State up to July 1, 1932, is therefore practically 7000.

Return records from ducks banded in California to the number of 1508 are avilable for study. Of these, however, 751 are of birds retrapped at the banding stations. Almost all these birds (661 Pintails, 78 Baldpates, and 12 Shovellers) were retaken at the Lake Merritt station, many being recaptured during two or three successive seasons. These "retakes" were not used in the present investigation, so the data on the map and here discussed represent 757 records. (Fig. 2.)

The intensive shooting that takes place in California is well shown by the number of banded ducks that were locally killed. Of the 542 local returns, 463 are for Pintails. The records farthest east—the one from Arkansas, the two from Louisiana, and the two from Manitoba—also are for this species.

The numerical status of the recoveries in the different States and Provinces clearly indicates that the ducks (at least the Pintails and the Baldpates) that migrate to California come from two major breeding areas, Alaska and the Provinces of Alberta and Saskatchewan.

The 38 returns from Alaska are divided into 32 for the Pintail and 6 for the Baldpate. The Alberta records are for 22

Pintails and 9 Baldpates, and those from Saskatchewan are for 11 Pintails and 2 Baldpates.

The migration route is probably entirely through the interior as there are no records from the coast of British Columbia or southeastern Alaska. Three of the returns from Yukon Territory are for Pintails, the fourth being for a Baldpate, while from Mackenzie there is one each for these species. In their journey southward these ducks apparently traverse the prairie regions east of the mountains, cross western Montana, and enter California through Washington and Oregon. A few of those that in previous seasons wintered in California evidently became associated with the flocks traveling southward through the Plains States. This is indicated by the few records obtained from all the row of States (Kansas excepted) from North Dakota to Texas.

The southernmost records of ducks banded in California are five from Mexico. Three of these are of Pintails recovered in the general vicinity of Mexico City; the other two are of Cinnamon Teal, one of which was recovered in the State of Jalisco and the second in Michoacan.

CONNECTICUT

Waterfowl-banding in Connecticut has been limited to the operations of Henry A. Bowden, of the Litchfield and Morris Game Sanctuary at Litchfield. Under the direction of the late John W. Titcomb, Superintendent of the State Board of Fisheries and Game, Mr. Bowden has banded systematically each year since the autumn of 1926. More than 1500 ducks have been marked, almost all of which were hand-reared birds. Because of this fact there is the possibility that their migratory flights may not follow the normal routes of wild individuals. It is believed, however, that upon release, the hand-reared birds associate themselves with wild flocks and travel from the area in their company. In other words, it would seem natural that when a small number of hand-reared birds are released, and are then associated with a larger number of wild individuals, they would be influenced in their movements by the latter.

The Litchfield station is one of the very few where large numbers of Wood Ducks have been banded, and despite the complete protected status accorded this bird by the Federal law, several return records have been received. Some of these Wood Ducks were found dead from unknown causes; two bands were recovered from the stomachs of owls (one in Connecticut and one in New York); while some of the ducks were accidentally shot by sportsmen. All together, 800 Wood

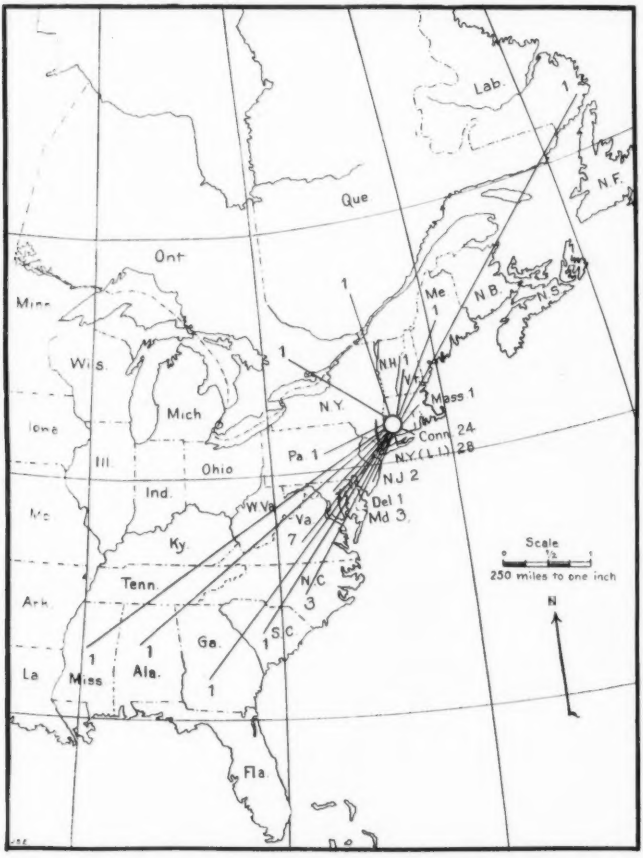

Figure 3. Distribution of Return Records from Ducks Banded in Connecticut.

Ducks have been banded at Litchfield, as well as 519 Mallards, 223 Black Ducks, and 1 Blue-winged Teal.

From these activities, 59 return records are available (Fig. 3) Of the 24 local recoveries, 18 are for Mallards. Only two other returns have been obtained for this species, one from Ontario and one from Vermont. This small percentage of returns from total bandings of more than 500 is truly remarkable, particu-

larly in view of the 28 returns received from only 223 banded Black Ducks. In its possible bearing upon the subject of restocking it might be discussed at some length.

Next to the local recoveries in point of numbers are those from Long Island, New York, consisting of seven for the Black Duck and one for the Wood Duck. Virginia is next in line with six and one respectively for these two species. No other State has reported more than three Connecticut ducks.

The long-range records to the south (Mississippi, Alabama, and Georgia) all pertain to Wood Ducks, while the one obtained on the coast of Labrador was for a Black Duck.

GEORGIA

The banding of waterfowl in Georgia has been limited to a single operation. During December, 1927, and January and February, 1928, Charles O. Handley and James S. Mason conducted a station at Mitchell Pond near Beachton. This point is in the Thomasville-Tallahassee district, and is only a few miles from the Florida line. The ducks banded consisted of 430 Ringed-necked Ducks and one Lesser Scaup. Return records to the number of 120 have been received, all being for Ringnecks.

The region around Thomasville, Georgia, and Tallahassee, Florida, is a Mecca for many sportsmen, which fact explains the large number of recoveries reported from these two States. As the banding was done during the open season, it was inevitable that many banded birds would be killed locally before they had started migration.

An examination of the map (Fig. 4) reveals an interesting and important situation. No returns for Georgia-banded birds have been reported from the ducking-marshes of the Carolinas, Virginia, and Maryland. The evidence clearly points to the crossing of the ducks in a western or northwestern direction to the Mississippi Valley, and thence north and west to the breeding grounds in Wisconsin, Minnesota, Manitoba, and Saskatchewan. With one exception, the recoveries in the lower Mississippi Valley were all obtained in succeeding seasons. The exception (No. 326499) was banded December 29, 1927, and was recovered January 30, 1928, near Remmel, in northeastern Arkansas. This record probably indicates the general region where the flight connects with the Mississippi Valley flyway.

ILLINOIS

The ducks banded in Illinois have been almost entirely Mallards, with a fair percentage of Pintails, a few Black Ducks,

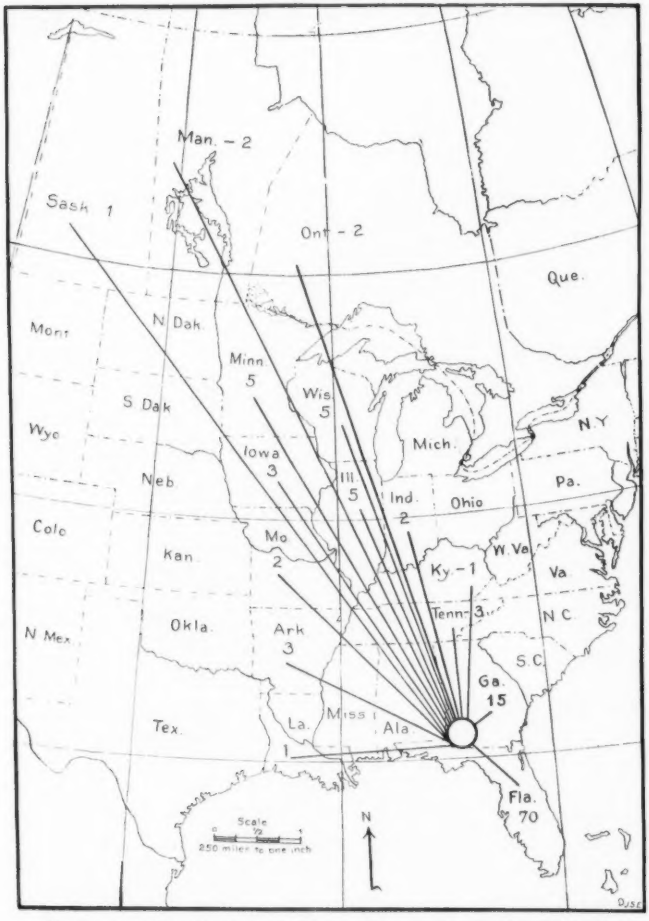

Figure 4. Distribution of Return Records from Ducks Banded in Georgia.

Blue-winged Teals, Green-winged Teals, Widgeons, Lesser Scaups, and one Greater Scaup. The total number banded is 3060.

The work was begun by the author in March, 1922, on the

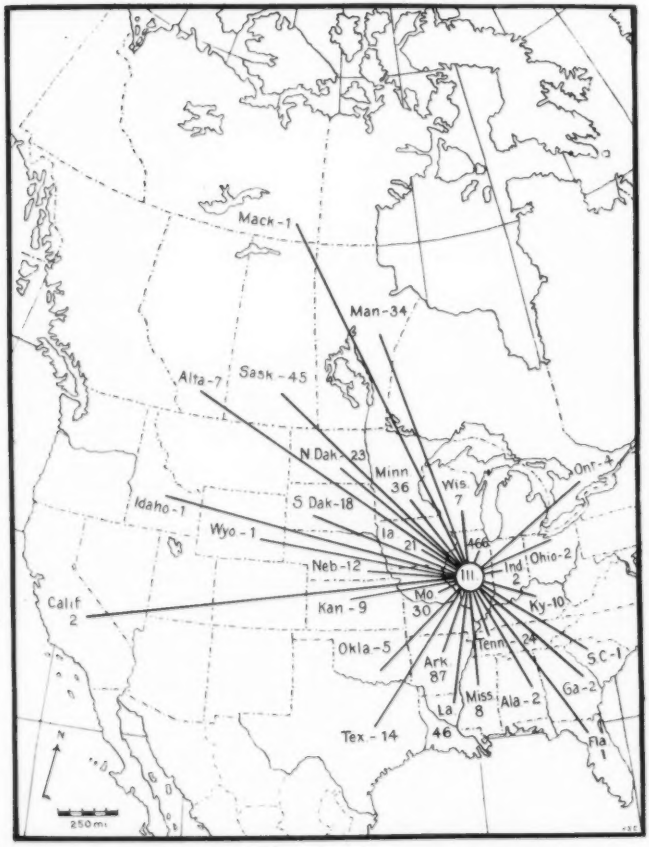

Figure 5. Distribution of Returns from Ducks Banded in Illinois.

grounds of the Sanganois Club near Browning, at which time 466 Mallards, Black Ducks, and Pintails were marked. In the autumn of the same year he banded 1338 additional birds. Again, during a few days early in January, 1926, about a thousand more were banded on a private shooting preserve at Crane Lake, near Bath.

T. E. Musselman started waterfowl-banding in February,

1926, marking 5 Mallards at Warsaw. At Lima Lake, near Meyer, during March, 1927, he banded 161 Mallards, Black Ducks, Pintails, and Blue-winged Teals, and 1 Greater Scaup Duck. During the same period in 1928, at some ponds and marshes near Quincy, he banded 100 Mallards, Pintails, and Widgeons; while in this same area in February, 1931, he added to his total 16 Mallards, Pintails, Green-winged Teals, and Blue-winged Teals. Four Lesser Scaups were banded in this area in March, 1932.

From these operations 921 return records have been received, of which 875 pertain to the Mallard, 15 to the Black Duck, 28 to the Pintail, 2 to the Lesser Scaup, and 1 to the Blue-winged Teal.

As much of the banding was done during the shooting season, the large number of local recoveries was to be expected, particularly since the banding stations have been located in regions where duck-hunting is intensive. The great importance of the Mississippi Valley flyway is well shown by the map (Fig. 5). The Provinces of Manitoba and Saskatchewan, and every State along the Mississippi River and west to the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, have reported a goodly number of Illinois-banded ducks. The chief breeding ground is indicated as being in Saskatchewan and Manitoba.

The single records from South Carolina, Florida, and Idaho, both of those from Georgia, and one from California, are of Mallards. The other California record is that of a Pintail (No. 204144) banded at Bath, January 6, 1926, and killed at Newark, California, November 3, 1926. One Pintail also was recovered near Fort Resolution, Mackenzie, this being the most northern record for a duck banded in Illinois.

IOWA

Although only 199 ducks have been banded in Iowa, the number of return records has been relatively large. The work has been done entirely by Allen Green, of Oakville, who started his station in the winter of 1923, and who each year since has banded Mallards and Pintails, with an occasional Black Duck.

Forty of these birds have been reported as returns. While eight are from Iowa (Fig. 6), this number is exceeded by those reported from Illinois, which may be considered, however, as in the immediate banding district. With one exception, all the other records are from the States of the Mississippi Valley flyway, the adjoining Plains States and the Prairie Provinces of Saskatchewan and Manitoba being included in this category.

Figure 6. Distribution of Returns from Ducks Banded in Iowa.

The exception is a Mallard (No. 102145) banded March 10, 1923, and killed October 21, 1923, at Los Banos, California.

It is of interest to note that, except those for twelve birds recovered in Illinois and one in western Tennessee, all the return records are from points west of the Mississippi River.

KANSAS

The waterfowl-banding station at Ellinwood, Kansas, operated by Frank W. Robl, is easily one of the most important in the country. This fact is due not only to its prox-

imity to the famed Cheyenne Bottoms, but also to its general geographical location, the large number of ducks banded there, and the diversity of the species that figure in the records.

Mr. Robl started this station during the fall of 1924, and it has been in more or less constant operation each succeeding season from November to March or April, and sometimes to May. The total number of ducks and geese banded up to July 1, 1932, is 6798. These are distributed as follows: Canada Goose, 44; White-fronted Goose, 2; Mallard, 1046; Gadwall, 6; Baldpate (Widgeon), 177; Pintail, 3726; Green-winged Teal, 515; Blue-winged Teal, 1100; Shoveller, 32; Redhead, 62; Ring-necked Duck, 1; Greater Scaup, 1; Lesser Scaup, 83; Buffle-head, 2; Ruddy Duck, 1.

From these operations 590 return records are available for study. As will be seen from the map (Fig. 7) ducks banded in Kansas have been recovered at points throughout nearly the entire continent, except the northeastern portion. In addition, one, a Blue-winged Teal, was killed in Cuba.

These records demonstrate clearly the important flight down the Great Plains from breeding grounds indicated to be chiefly in the Prairie Provinces of Canada and probably also in the Dakotas, Nebraska, and Minnesota, and to a lesser degree in the Northwest Territories and Alaska. The normal western boundary of this flight is evidently the Rocky Mountains, while the eastern overlaps the Mississippi Valley flyway. Most of the birds using this flight-lane winter in Texas and Louisiana, but it is evident that a relatively large percentage of them push on south to Mexico, where they disperse widely. Returns have been reported by our southern neighbor from no fewer than ten States and the Federal District. These Mexican recoveries are all of Pintails and Blue-winged Teals. The two records from Honduras are also of Blue-winged Teals, both being male birds that were banded in April, 1930. One (No. A510183) was killed in November, 1931, and the other (No. A500237) was taken in February, 1931.

The records from banded ducks indicate the Pintail to be the most widely ranging of our native wildfowl. All ten of the Alaskan returns, three of those from Yukon Territory, all four from Mackenzie, the single record from Washington, the three from Oregon, the one from Idaho, the one from Nevada, and 39 of the 41 from California relate to this species. Also, the single record from the Atlantic coast is of a Pintail (No. 600869) banded May 4, 1928, and killed in Jasper County, South Carolina, November 21, 1928.

The fourth record from Yukon Territory is of a Mallard

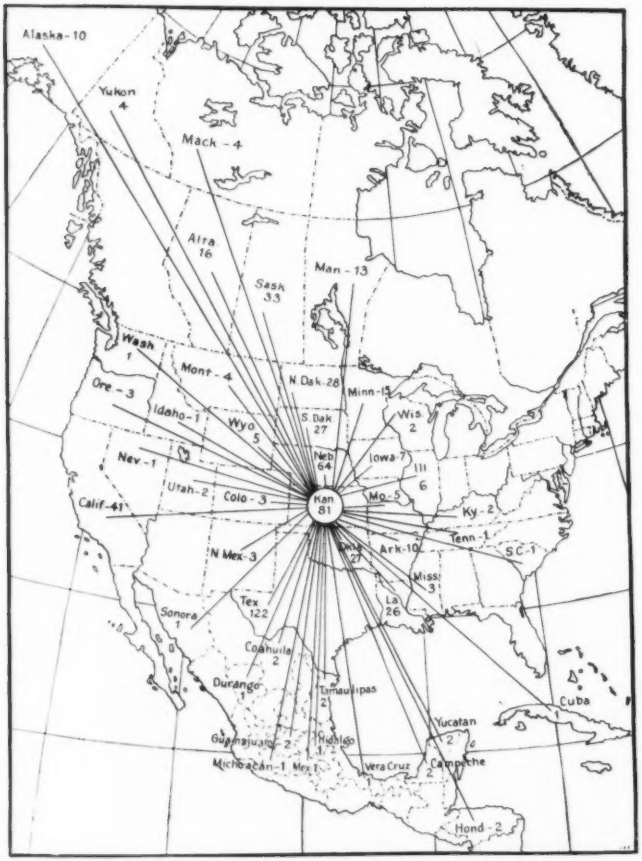

Figure 7. Distribution of Returns from Ducks Banded in Kansas.

(No. 423241) banded February 11, 1930, and killed at Mayo during the autumn of 1931. The remaining two California records are both of Green-winged Teal.

Biological Survey, Washington, D. C.
December5, 1932.

EXPERIMENTS WITH THE TERRAGRAPH ON THE ACTIVITIES OF NESTING BIRDS[1]

By JOSEF BUSSMANN
Hitzkirch, Switzerland

THE terragraph is an electro-magnetic instrument for recording the activities of birds and mammals; it was invented by the German Count von Hegendorf[2] and used by him to study the habits of foxes and badgers. I constructed a somewhat similar model, that registered with lines instead of dots.

Although I have made some studies on mammals, I have chiefly used the terragraph to determine the number of feedings per day given the young by birds nesting in cavities, in order primarily to investigate the subject of economic value. Statistics calculated from my results proved the usefulness of our songbirds. With these figures I have been able substantially to further the cause of bird-protection in my home.

Description of the Terragraph. The apparatus consists of a clock with a horizontal disk attachment 19 cm. in diameter which makes one revolution with the clock in each twenty-four hours. On this disk is placed a paper dial-plate marked with hours and half-hours with a carbon paper on top, both being held in place by a tin disk 15 cm. in diameter, which is tightened by means of a central nut.

A telegraph magnet with a pencil attachment is stationed near the disk. When the circuit is made, the pencil presses on the carbon paper, making a short line 4mm. in length on the paper disk beneath (See Figure 3).

The contact at the nest consists of two small pieces of wood fastened together at one end by a flat steel spring. This contact is placed in circuit by means of insulated copper wire with two pocket batteries and the telegraph magnet, so that when a bird alights on the contact the magnet records on the paper disk.

Feeding the Young. The number of feedings in one day in the case of 13 broods of 11 species is shown in Table I. In every instance both parents fed, but with the Pied Flycatcher the male took but little part.

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[1]Translated by Margaret Morse Nice, to whom grateful acknowledgments are due for the suggestion to write this paper for *Bird-Banding*.
[2]Der Terragraph; 1912. Leipzig.

TABLE I

NUMBER OF TIMES YOUNG WERE FED IN ONE DAY

Species	*Number of Young*	*Age in Days*	*Date*	*Number of Feedings*
Green Woodpecker (*Picus viridis*)	3	1	May 11–12	18
		2	May 12–13	17
Wryneck (*Jynx torquilla*)	5	1	June 19–20	141
		2	June 20–21	137
Pied Flycatcher (*Muscicapa hypoleuca*)	5	2	July 11–12	285
Starling I (*Sturnus vulgaris*)	5	3	May 12–13	242
		12	May 23–24	208
Starling II	4	8	May 8–9	107
		11	May 11–12	158
Great Tit I (*Parus major*)	8	4	May 15–16	371
		5	May 16–17	390
Great Tit II	7	10	May 20–21	393
Blue Tit (*Parus cæruleus*)	9	3	May 26–27	350
Nuthatch (*Sitta europæa*)	5	4	May 26–27	370
Tree Creeper (*Certhia brachydactyla*)			June 26–27	152
			June 27–28	78
Song Thrush (*Turdus philomelus*)	5	1	May 26–27	91
		2	May 27–28	142
Redstart (*Phœnicurus phœnicurus*)	5	6	June 8–9	203
Tree Sparrow (*Passer montanus*)	5	2	May 23–24	310
		3	May 24–25	251

With the exception of the Green Woodpecker, the feedings average from once every 12 minutes (Tree Creeper the second day) to once every 2.4 minutes (Great Tit), if we count 15½ hours to the day. The average of the 19 days' records is a feeding once in every 4.1 minutes.

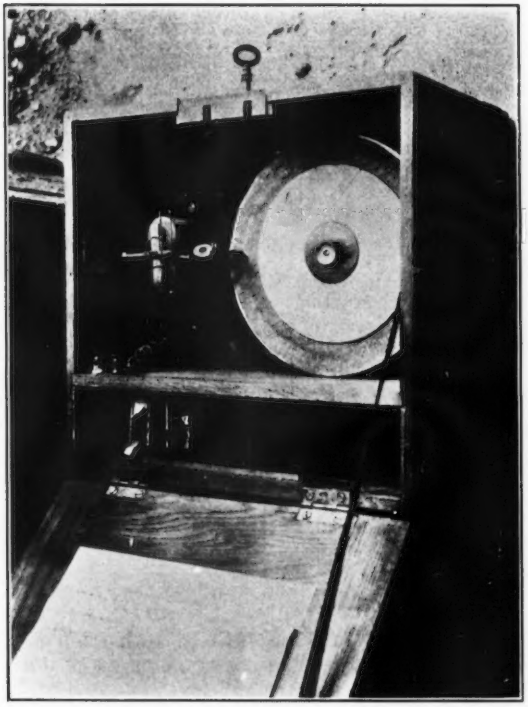

Figure 1. Terragraph in case viewed from above.

In marked contrast to this intense activity is the behavior of *Picus viridis* with only 17 and 18 feedings a day, *i.e.* once in about every 50 minutes. The explanation lies in the fact that this bird feeds by regurgitation. Each feeding lasts from three to five minutes.

An even smaller number of meals was recorded in the case of a pair of Little Owls (*Athene noctua*) with four young 21 days

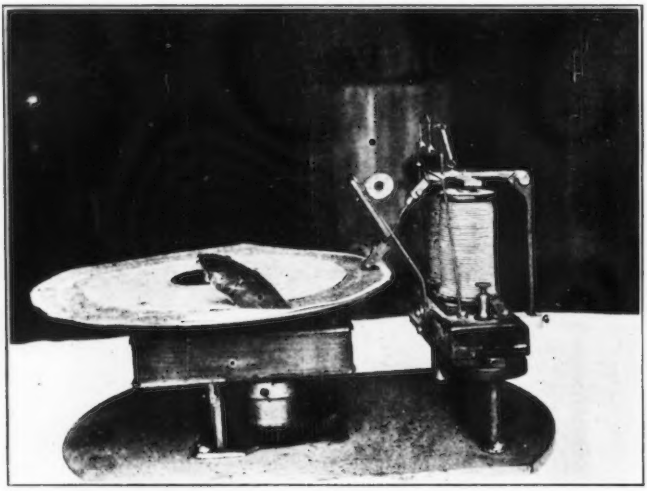

Figure 2. Terragraph removed from case. A piece of the carbon paper lifted to show record below.

old; during the night of June 15th to 16th from 5 P.M. to 3.15 A.M. there were 12 feedings, none being given during the day.

The amount of food brought to the young varies in many cases according to the weather. Starlings and thrushes that depend upon worms, grubs, beetles, etc., have an easier task in wet weather. But birds that capture gnats, crane-flies, and flies fare much better in dry weather. I have known of broods of flycatchers and swallows perishing of hunger after a long spell of rainy weather.

In Table II details are given of the records of three broods, with the number of feedings shown during different periods of the day.

TABLE II

FEEDING OF THREE BROODS DURING DIFFERENT HOURS OF THE DAY

Species	*Weather*	*Date*	*Hours*	*Number of feedings*	*Average Number per hour*	*Total*
Tree Creeper	Warm, but cloudy	June 26–27	4.10– 8.00	53	14.9	
			8.00–10.00	8	4.0	
			10.00– 1.00	31	10.3	
			1.00– 5.00	39	9.8	
			5.00– 8.00	21	7.0	152
	Rainy	June 27–28	4.45– 8.00	8[1]	2.4	
			8.00–10.00	16	8.0	
			10.00– 1.00	17	5.7	
			1.00– 5.00	22	5.5	
			5.00– 8.15	15	4.6	78
Tree Sparrow	Fine	May 23–24	4.40– 8.00	83	24.9	
			8.00–10.00	40	20.0	
			10.00– 1.00	58	19.3	
			1.00– 5.00	71[2]	18.0	
			5.00– 8.15	58	18.0	310
	Fine	May 24–25	4.30– 8.00	34	9.7	
			8.00–10.00	23	11.5	
			10.00– 1.00	52	17.3	
			1.00– 5.00	77	19.2	
			5.00– 8.25	65	19.0	251
Starling	Fine, but cool	May 12–13	4.45– 8.00	68	21.0	
			8.00–10.00	31	15.5	
			10.00– 1.00	33	11.0	
			1.00– 5.00	67	16.8	
			5.00– 8.35	43	12.0	242
	Fine, but warm	May 23–24	4.50– 8.00	55	17.4	
			8.00–10.00	33	16.5	
			10.00– 1.00	46	15.3	
			1.00– 5.00	46[3]	11.7	
			5.00– 7.25	28	11.6	208

With the Tree Creepers there was a period of 80 minutes and with the Tree Sparrows one of 40 minutes in which no feedings were recorded; with the Starlings at one period only 10 meals were brought in an hour and a half. The causes of these interruptions were not known, but observations at other nests have shown that similar irregularities occurred when the

[1]No feeding from 5.05–6.55.
[2]No feeding from 3.30–4.10.
[3]Only 10 feedings from 3.00–4.30.

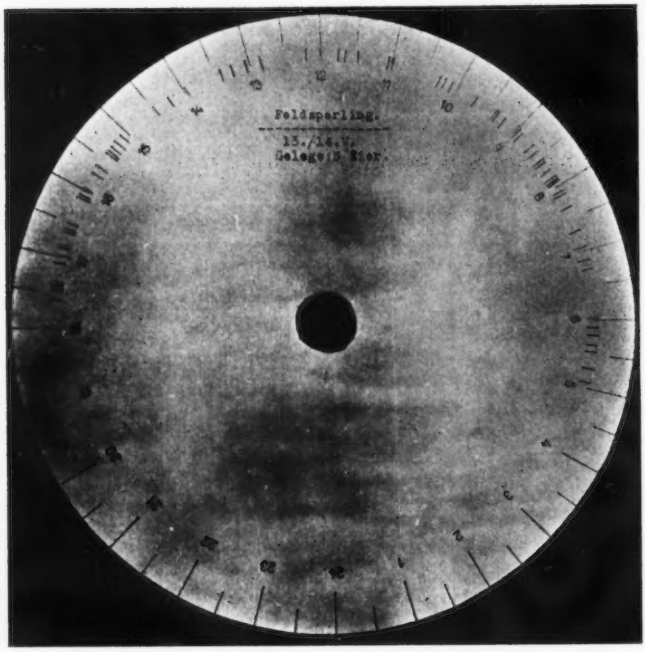

Figure 3. Terragram of a Tree Sparrow's nest during incubation.

parents were frightened by people, Magpies (*Pica pica*), or cats.

If the three periods of disturbance are omitted, the average number of feedings per hour for the different times of day are as follows: 4 A.M to 8.00, 17.1; 8.00 to 10.00, 12.6; 10 to 1.00 P.M., 13; 1.00 to 5.00, 13.7; 5 to 8, 11.4. The most rapid feeding came early in the morning, but a high level was maintained throughout the day with somewhat of a drop towards evening. This rhythm was followed the first day by both the Creepers and the Tree Sparrows and both days by the Starlings, except that the latter during one day fed the least around noon. The Tree Sparrow on the second day fed the least at first and far more from 10 till evening.

Incubation. Records from the terragraph and personal obser-

vations have given interesting results in the matter of incubation, showing that this process is much less intensive in general than has been believed.

A female Wryneck left her eggs as often as 40 times a day; being especially active early in the day and late in the afternoon. Observations with my telescope showed that in this case the female, a banded bird, took sole charge of incubation. A female Redstart left the nest as many as 30 times in a day, often leaving when her mate came to the entrance of the hole, not however that he fed her or assisted with the incubation.

At a box containing four Tree Sparrow eggs on May 10 the terragraph showed much activity. Observation revealed that the male was continually coming to the entrance and enticing the female out. On this day she left 25 times, on the next 30, but on May 12, when the set was complete, 13 times. With this species the male takes some part in incubation.

The most restless sitter of all was a Pied Flycatcher. On May 29 to 30 and 30 to 31 (four days before the eggs hatched) the female left the nest as many as 90 times each day. A constant coming and going took place at the nest-hollow; seldom did the bird sit 10 minutes, and often it was only two minutes before she slipped off to catch a fly, visit with her mate, or attend to her toilet.

At a nest of the Song Thrush the male took no part in incubation nor did he feed the female. On May 18 to 19 the latter left the eggs 21 times, the next day 20. May 20 I watched her behavior with my telescope from 11.00 to ten minutes past 1.00 and found she spent 70 minutes incubating and 60 minutes away from the nest in the following periods—the periods off being enclosed in parentheses: 25 minutes, (10), 10, (5), 35, (45). Five days later I watched from 12.00 to 5.30; the total times spent on the nest was 200 minutes, off 130. The weather was fine on both days and approximately the same temperature—80° F. On this day her periods both on and off averaged much longer than on May 20: (70), 80, (35), 90, (15), 20, (10), 10. At 5.25 the first egg hatched, the second at 6.15, the third at 6.50, while the other two young were out early the next morning.

The great Black Woodpecker (*Dryocopus martius*), a rare bird that digs its home in a living tree, was found by personal observation on two nests to have a very regular schedule in the matter of incubation. The female incubates from about 5 P.M. to 7 A.M., the male from 7 to 11, the female from 11 to 2, and the male again from 2 to 5.

Sleeping Habits of Woodpeckers. During one winter I in-

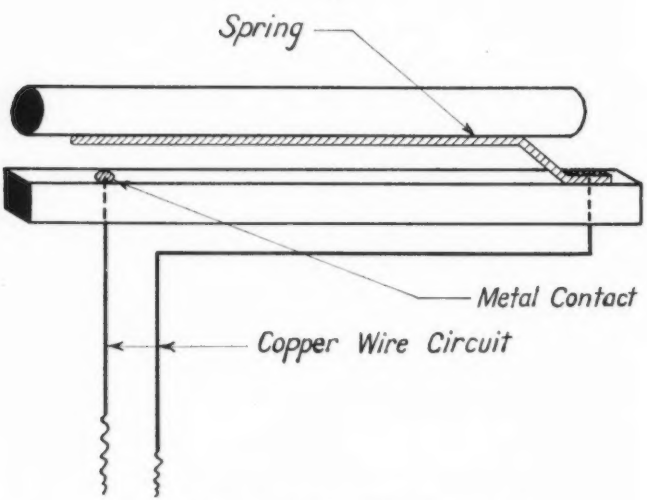

Figure 4. Diagram of Electric Contact at Nest.

stalled the terragraph in a beech wood where five holes of the Black Woodpecker were used by individuals of this species and also of the Green Woodpecker and Gray Woodpecker (*Picus canus*). There was considerable quarrelling over the sleeping-quarters; sometimes a bird would leave its hole to chase off an intruder, only to have a third individual slip in and refuse to be dislodged. On November 20 the terragraph showed that the hole was occupied from 5.15 P.M. to 7.35 A.M.; while the next afternoon, which happened to be cloudy, a bird entered at 4.50 and did not leave till 7.50 the next morning.

Accounts of all these and other observations have been published in Switzerland in *Der Ornithologische Beobachter*[2] and *Mittelschule*.[3]

[2]Vol. 21, pp. 17–20, 168–170; Vol. 22, pp. 77–78, 157–158; Vol. 25, pp. 22–25; Vol. 27, 17–21; Vol. 28, pp. 151–155; Vol. 29, pp. 129–130, 153–156.
[3]Vol. 11, No. 2; Vol. 14, No. 5; Vol. 15, No. 6.

THE SIZE AND MEASUREMENT OF TERRITORY IN BIRDS

By HERBERT FRIEDMANN[1]

EVER since H. Eliot Howard brought the concept of the breeding territory clearly before ornithologists its usefulness in understanding and interpreting the behavior of individual birds has increased in direct proportion to the number of students working intensively on life-history problems. In fact, so useful has this concept proved to be that even if it were not based on a factual foundation it would still be worth keeping as a working hyopthesis. A great mass of data was produced by Howard in support of his concept, and since the publication in 1920 of his book "Territory in Bird Life" a still greater amount of new data has been collected and put on record. The subject is one of intense interest to all students of bird behavior, and it is the purpose of this paper to attempt an analysis of one aspect of what has been learned of territorialism generally, the size of territories and the measurement of that size.

The idea of territory has always been looked upon as a matter of spatial dimensions. Thus, a certain bird with a given food-habit might need a large area to supply its wants and those of its young, while another species might need only a fraction of the geographical area occupied by the first one. Hence, the size of the territory varies with the species, and, to a lesser extent, within the species. Some forms, particularly sea-birds such as Gannets, Murres, Auks, etc., that nest on rocky ledges of sea-bound islets and have in common the foraging ground of the surrounding waters, have practically no individual spatial territories, the nests sometimes being so close together that the sitting birds actually touch one another. Still, while no bigger than the nest it contains, the territory of each bird is at least a theoretical reality; the relatively small number of nests containing mixed clutches of eggs speaks for the individuality of the breeding sites. Furthermore as intimated above, the concept of territory is so useful in correlating what would otherwise be isolated fragments of behavior that it behooves us to grant territoriality even in such extreme cases as these sea-birds, rather than to take the opposite view.

However, territory is not merely a matter of space-extension; it is also a matter of time-duration. The same spot cannot

[1]Published by permission of the Secretary of the Smithsonian Institution.

serve as a breeding territory for two pairs of a species simultaneously, but may well do so if one pair comes after the other is gone. Hence it follows that the measure of a territory must be made in space-time units and not in those of space alone. The territory is the unit of local distribution just as the cell is the unit of biological structure, but in distributional data the factor of population numbers of a given species is correlated with the total of all the individual territories of that species in any given area. Hence it follows that if the actual geographical ranges of two species be wholly coincidental, and if in one of the two birds the same actual spatial areas may be used twice in a season as territories, while in the other they may be used but once, the former species has, to all intensive purposes, in a comparative sense, twice the distribution of the latter. We must distinguish between the meaning of distribution in the biology of the bird and in the statistics of the zoögeographer. Unfortunately the two are quite dissimilar.

Just as we find the size of the breeding territory varies in different species, so, too, we discover that the length of time the territory is occupied differs in different kinds of birds. On the whole, the time-duration of a territory in the case of the average small altricial bird is equal to the time of nest-building plus that of egg-laying plus that of incubation plus the nest life of the young plus at least a few days after the young leave the nest. Probably, to be more accurate, we should add on a few days at the beginning between the acquisition of the territory and the inception of nest-building. In precocial birds, on the other hand, such as ducks, gallinaceous birds, and some limicoline forms, the territory has a different time-duration; in these it is equal to the time of nest-building (which is sometimes negligible) plus that of egg-laying plus that of incubation and occasionally plus a few days after the young hatch out. The fact that the territory as such does not come into existence until very shortly before nest-building commences, in many species, is indicated by the non-individual territorial aspects of the "dancing-grounds" or "tournament-fields" of some gallinaceous birds, such as the Blackcock, or some shorebirds, such as the Ruff, etc. In these birds the courtship and securing of a mate are done, not in an individual territory, but in a common, gregarious playground. Furthermore, inasmuch as the incubation and nestling periods differ in various birds, it is obvious that the time-dimensions of the territories vary accordingly. In the case of birds that use old nests already present, the time-duration of the territory is shortened accordingly; in the case of parasitic birds in which the territorial complex has been studied, as in the Cowbirds, the time-duration is

rather peculiar in that it is equal to the time required for the nest-building and egg-laying periods of the victims, plus a few days over, but not including the total period of incubation, to say nothing of the nestling period. This last special type of time-duration appears to hold true for some of the Cuckoos of the Old World as well. Thus, Chance, Rey, and others have found that the European Cuckoo (*Cuculus canorus*) finds its victims' nests by watching them build. If the nests are destroyed and new ones built to replace them, the parasite continues to lay (in this way Chance was able to get over twenty eggs from one Cuckoo in one season), whereas ordinarily the parasite would stop laying after the nests of its particular host species had reached the incubation stage. The reason for this is that with the end of the egg-laying period of the victims the Cuckoo's territorial instincts begin to diminish and finally disappear. It is then that a second Cuckoo may invade the territory of the first one.

Thus, to summarize the facts outlined so far, we have a great many possible combinations of component parts of the life-history of a given bird, any one of which may be reflected in the dimensions (spatial and temporal) of its territory. It follows then that all territories are not necessarily comparable as they are not all based on the same ethological materials. But the end is not yet; a further complication awaits our attention. This has to do with the consideration of the territory of a pair of birds as a summation of, or as a compromise between, the individual territories of the two individual birds comprising the pair. Howard, Selous, and others have given many instances in which the territories of the male and of the female were not altogether identical; in fact, in most of our passerine birds that have been studied intensively the time-duration of the same identical spatial territory is different for the male and the female. The male usually arrives first in the spring and establishes the territory, which, therefore, has an earlier time-limit for him than for the female arriving later. Just as here we have the two sexes differing, with respect to territory, in time-dimensions, so we have numerous cases where the difference is in spatial terms. Thus, in tropical East Africa, a long-tailed Widow-bird, the Jackson's Whydah, (*Drepanoplectes jacksoni*), presents a striking example. Here the male makes a little individual dancing-ground, a small circle of depressed and trodden grass in a field of tall upright grasses. He remains in this little area and does all his courting displaying in it, until he has secured one or more mates. The important point for our immediate problem is that the location of the dancing territory bears no relation to the actual breeding

territory (including the nest-site) of the female. Here we have a case where the breeding territory is really the territory of the female; the same situation may be found in the Bower-birds of the Australian region (*Ptilonorhynchidæ*). The other type of condition is that in which the display ground of the male (the singing-tree of Mousley and others) coincides to a greater or lesser extent with the breeding territory of the female (including the nest-site). This is the type found in most of our small birds. Exceptions or marked modifications are by no means uncommon, however; we need only recall such birds as those in which the male never comes near the nest, Hummingbirds, etc., or those in which the picture is the same but with the sexes reversed, as in the Phalaropes. As far as our attempt to measure territories in quantitive space-time units is concerned, we have here two different problems. In the first type, the breeding territory is a single entity, the territory of the female; in the second type the breeding territory is a welding of the territories of the male and the female; in other words the type that we have come to look upon, through abundant personal contact and experience, as the "normal" type is really a compromised summation of two territories into one. This naturally results in an extension of the limits, both in space and time, of the resulting territory. It seems, from the fact that separate male and female territories are found chiefly in the "lower" groups of birds (gallinaceous, limicoline, etc.) with relatively few cases among the "higher" families, that the separate condition may be the older one. With the advent and development of accelerated hatching time, resulting in the altricial natal state, there may have come about a tendency to merge the territories of the two responsible parents. This is really beside our problem, but we must realize in any scheme of measuring territories that we are sometimes dealing with a single "primal" territory, and sometimes with a double, secondarily unified one. The degree of unification or merging is another variable factor that has to be considered.

The actual measurement of a territory of a given species, in order to be of value in a comparative way, will have to be made with all these variables in mind. The day is not yet here when our knowledge of enough such specific territories is sufficient to enable us to make any generalizations of more than temporary value. The first step is be made is to classify territories of species according to their basic nature; whether they are primal or secondarily unified territories is the first criterion to be judged. These two words may well be adopted in describing the territorial picture in any species, primal or merged. With this as a basis we may then state the time-limits in terms of the

parts of the reproductive cycle actually spent in the spatial confines of the territory. The spatial dimensions would have to be in some convenient measure, such as square meters or yards. Thus, we might measure a hypothetical territory and express our results as follows: "The territory of ——— species is of the primal type and occupies approximately 500 square meters over a period of nest-building (2 days) plus egg-laying (6 days) plus incubation (28 days) plus 3 days after hatching (precocial); a total of 39 days." or, again: "The territory of ——— species is of a merged type and occupies approximately 100 square meters over a period of courtship (6 days) plus nest-building (4 days) plus egg-laying (5 days) plus incubation (15 days) plus nestling period (11 days) plus 5 post-nesting days, a total of 46 days. The male alone occupies the territory for the first 4 days."

The probabilities are that some simpler, better method will be found as the measurements of territories in many birds are attempted; the plan given here is more in the nature of a suggestion than anything else. The main point of this paper is to stress the various combinations of factors (other than food, which is obvious) that have a resulting influence on the size of the territories, and to distinguish between them.

BANDING WILSON'S PETRELS

By SAMUEL A. ELIOT, JR.

To any one becoming interested in the possibilities of bird-banding, the following passage could not but be suggestive. It is from "The Story of a Bird-Lover," by W. E. D. Scott, a prominent ornithologist of the last century, and refers to August, 1881.

"With a fisherman I left Chatham, Massachusetts, very early one morning and by daylight we were far out at sea. A gun and ammunition were part of my equipment, and as occasional birds were seen in the distance I thought it worth while to begin my preparations. I saw an amused look pass over the captain's face as he said to me, 'Better wait till we get where the birds are; it will be easier to get 'em!' After two hours' sail—we were now out of sight of land—he announced that we had arrived on the fishing-banks, and that he would make a try. This seemed to be entirely foreign to the work I had come out to do, but I did not interfere. Without anchoring the boat, simply heaving to, he baited a couple of codfish lines and lower-

ing them soon had two large fish struggling in the bottom of the boat. . . . When some eight or ten were in the boat he said he would show me the birds that frequented the banks. He then took out the livers of several of the codfish and cut them into very minute pieces, grinding these into pulp. This 'chum' was cast overboard to float on the water. A long oily streak on the surface soon indicated the run of the tide . . . and following this oily streak or lane, allured by the bits of liver, the birds I had seen at a very considerable distance began to arrive in the vicinity of the boat. Shortly, birds were about us in countless numbers . . . the stormy [Wilson's] petrel, the greater shearwater, the sooty shearwater, and an occasional parasitic gull [Jaeger]. Before collecting any specimens, it seemed worth while to examine the birds with care, for I feared that with the report of the gun they would be frightened away; so I waited for a time. The captain now took a piece of string some seven or eight feet long, fastened a large piece of cod-liver to it, and allowed this to float out at the stern of the boat. I had thought the birds were quite fearless but was not prepared to see them come to such close quarters. As soon as they detected the large piece of liver tied to the string, they thronged about it like flies about a lump of sugar. Gradually the cord was shortened until the bait was not more than three or four feet from the gunwale. From the cabin the skipper brought an ancient crab-net with a long handle, and presently he was catching the three kinds of petrels much as one catches butterflies, emptying his net as he caught each bird into the cock-pit of the boat. Here they were absolutely helpless, as from such a flat surface it was quite impossible for this kind of bird to rise on the wing, and they walked about much after the fashion of chickens and with about as much commotion as fowls make when intruded upon. Shortly, all appeared to be affected by the motion of the boat and began to disgorge what they had eaten, and the cock-pit was now a scene of filth which can better be imagined than described. Of course it was not necessary to use a gun. . . . At a single sweep of the net, the captain took nine of the little birds. We selected such as seemed of particular value [as specimens] and allowed the rest to go overboard, where on reaching the top of a wave they immediately took flight." Thus wrote Scott.

"Well," I thought to myself, "what could be done in 1881 can be done in 1932. I doubt if any one has ever banded these sea-birds. What fun to be the first!" So I sent to Washington, with a very brief explanation, for bands of the size to fit Shearwaters (a type of bird not even mentioned in the Manual for Bird-banders), and though the official who sends out bands

thought (as he afterwards told me) that I was crazy, he forwarded a string of No. 5's. I already had a lot of No. 2's, the size the Manual recommended for Petrels. A party of bird-students whom I knew were considering a sea-trip out of Chatham to observe, merely, birds of this sort, and on August 16th I joined them. Next morning, through the early fog, eight men[1], all more or less seasoned ornithologists, set out in a fisherman's launch and chugged steadily toward the banks. A trawler and her line of dories came into view on the horizon, and round her we could see a swarm of birds. Wilson's Petrels (*Oceanites oceanicus*) flitted by us more and more commonly, and as the land sank behind us to a mere sandbar, a Cory's Shearwater was seen. Within a few miles of this very spot, on October 11, 1880, the first Cory's Shearwater known to science had been obtained. Several came within our purview, but their usually more numerous cousins, the (smaller) Greater Shearwater, made no appearances, and the Sooty Shearwater only an unsatisfactory one, at a great distance. Eager for cod-livers wherewith to tempt them nearer, most of us started fishing, and by-and-by I was crumbling the oily stuff over the side with mounting excitement; for the little black chippering Petrels found it at once and began flying fearlessly within easy reach of the fisherman's long-handled net. The weather, however, was not the flat calm that must have favored W. E. D. Scott, for our launch was drifting before a breeze up which all the Petrels flew. It was necessary to drop the liver-chum over the lee side, well aft; then, as the boat drifted, the chum passed under her stern, and rapidly away to windward; and only the boldest, hungriest Petrels pounced on it before it was several yards away from us. We did get a constant stream of them flying under our stern, and I began valiantly wielding the net.

It was no butterfly-net. Designed for scraping whelks off the sea-floor for bait, it had a heavy iron hoop, a short, coarse-meshed bag, and a ponderous wooden handle. A dozen lunges at the dodging birds "winded" me entirely. And my skeptical comrades would do nothing but jeer and boo at my panting efforts. For perhaps half an hour I doggedly struggled, crumbling liver over, seizing the great net, and swooping at the elusive flutterers who thronged towards it. At last I caught one, and the tune changed. One friend held the Petrel while I attached a No. 2 band, and discovered that No. 2 was too big. Others asked for turns at the net. One man would bang it down over a Petrel, completely submerging the poor bird.

[1]They were Aaron C. Bagg, Ludlow Griscom, Dr. John B. May, Wendell Taber, John H. Conkey, George L. Perry, and Charles E. Clarke.

Others failed to twist the net inboard fast enough, and the prey escaped from the shallow bag. But they began to catch birds faster than I could band them, and I remembered that Scott's captives had been unable to rise from the cockpit. Alas, on this breezy day, Petrels turned loose in the cock-pit had little difficulty in getting a puff of air that wafted them neatly out of our reach. Each one had to be held, and soon some of my companions had a Petrel in either hand. It was hopeless trying to put on my No. 1a bands in sequence: I had only twenty or so of that size, and they were remnants of three different series. As rapidly as possible I wrote down each number, pinched the band on above the little yellow-webbed foot, and watched the released bird fly straight and fast as an arrow down wind away from that boat! They never paused nor swerved, and were indifferent to the hordes of their fellows pressing up wind past them toward the feast of bait.

Twelve I banded, before accident befell. His hands all slippery with cod-liver oil, one of the party grabbed the net for his turn, made a mighty lunge, and away went the greasy pole through his palms, entirely out of reach and promptly dragged to the bottom by its iron hoop. We continued to pull in cod and strew liver, and had the Petrels in jabbering, squeaking hordes almost in hand's reach, but the catching and banding were over. Attracted by the throng of birds, several Parasitic Jaegers investigated us, and just as we turned about for the return trip a splendid Pomarine Jaeger came. So despite the mischance, the trip was voted a complete success, and I had proved my point that Petrels, if not Shearwaters, could be caught wholesale by a properly prepared banding-expedition.

Such an expedition should be equipped with several light-weight, deep-bagged nets at the end of long, light poles, perhaps of bamboo. It should carry some bait along, in order not to be dependent for it on fishermen's luck. Cod-livers are probably purchaseable, and I have heard that cheap, veterinarians' castor-oil is equally alluring to the birds. To prevent too rapid consumption or loss of bait, especially on a breezy day, a cod-liver might be made fast to a shingle or bit of cork, so as to float naturally and yet be tied to the boat. It was amply clear that Petrels would hover in clouds over such a piece of bait as that; one might catch several together. In the cockpit there should be a coop or deep barrel, into which to stow the captives that cannot at once be banded. Hundreds, literally, could be tagged in a few hours by such a trip, and were the practice an annual one, recoveries would pretty certainly be made. Then sooner or later the far-southern islands where Wilson's Petrels breed would be visited, and birds that had

been banded off Massachusetts recovered in their home burrows. What a thrill, to be a party in both enterprises, banding at sea in summer and burrowing for the same birds in winter!

It is hardly probable that any of the twelve who wear my bands will be heard from; but let hundreds or thousands be banded at different points off our coasts, and some returns would seem certain.

Smith College, Northampton, Massachusetts.

GENERAL NOTES

Mortality of Banded Hawks and Owls.—An analysis of the recoveries expressed in percentages in the table submitted herewith indicates very closely the comparative efficiency of custom and law in the protection of our raptors. Comparison of the protected birds in Group I and the unprotected birds of Group II shows a mortality rate of over two and one half times among the more destructive species. Unfortunately the figures show also a distressing mortality among Group III, raptors which should be but are not generally protected.

Another method of approach is a comparison of mortality rates among different groups of birds as represented by recoveries. The table clearly indicates the fact, which is generally known but not often shown so forcibly, that birds which are exposed to hunting or which lack complete protection have an excessively high mortality. The case of the hawks, which raise small broods in contrast to the ducks, which require a comparatively large territory for breeding purposes, and which have no group of people like sportsmen interested in their propagation, but instead have many avowed enemies, therefore becomes a serious one. The corollary to lower mortality rates of the protected species is more protection of the others if the raptors are to survive. Of course, it is possible to give reasons why these percentages will not be absolutely accurate, but still I believe the trend is clear.

	Number Banded	*Recoveries*	*Rate in Percent*
I			
2 Vultures	188	2	1.6
Osprey	175	11	6.3
Barn Owl	679	35	5.2
5 Other Owls (except Screech Owl[1] and Great Horned Owl)	568	16	2.8
Sparrow Hawk	391	24	6.1
	2001	88	4.4 average
II			
3 Accipiters	247	31	12.6
Great Horned Owl	209	20	9.6
	456	51	11.2 average
III			
Marsh Hawk	367	52	14.2
4 Buteos	473	50	16.6
2 Roughlegs	63	9	14.3
3 Falcons (except Sparrow Hawk)	94	13	13.8
2 Eagles	53	3	5.7
	1050	127	12.1 average

[1]Screech Owl figures omitted because most of the recoveries were of birds recaptured and released, not of birds shot.

GROUP I—PROTECTED BIRDS

	Banded	*Recoveries*	*Rate in Percent*
Passerine birds, Austin Station, 1930 and 1931	[2]7031	9	.13
Sea-birds (Gulls and Terns), 1930 and 1931	[3]8042	15	.18
Passerine birds, M. J. Magee	[4]18459	59	.32
Black Skimmers, Gillespie	[5]290	7	2.4

GROUP II—BIRDS CUSTOMARILY SHOT

Purple Grackle, McCann	[6]305	33	10.8
All Hawks and Owls except the Screech Owl (included are all the protected species in first table, Group I)	[7]3507	266	7.6
Ducks, 1920–1926	[8]12119	1675	13.82
Unprotected Hawks and Owls	1506	178	11.8

[2] and [3] *Bird-Banding*, Vol. III, No. 2, pp. 59–63.
[4] *Bird-Banding*, Vol. III, No. 3, pp. 111, 112.
[5] *Bird-Banding*, Vol. II, No. 2, p. 52.
[6] *Bird-Banding*, Vol. II, No. 4, p. 174–176.
[7] Dr. F. C. Lincoln *in litt.*, Aug. 2, 1932.
[8] Dr. F. C. Lincoln, U. S. Dept. of Agriculture, Circular No. 118, May, 1930.

—Warren F. Eaton, 128 Wildwood Ave., Upper Montclair, New Jersey.

Mortality in Marsh Hawks.—In June and early July, 1930, Dr. Paul L. Errington, of the University of Wisconsin Bird-Banding Station, banded twenty-five young Marsh Hawks (*Circus hudsonius*) in the vicinity of Madison, Wisconsin. The bands were applied very shortly before these birds were able to fly. In June and early July, 1931, he banded twenty-two more, making a total of forty-seven.

Of these, reports have since been received concerning the following:

A626610, banded June 11, 1930; shot, Mineral Springs, Arkansas, Feb. 1, 1932.
A626613, banded June 11, 1930; shot, Elgin, Texas, Dec. 25, 1930.
A626615, banded June 11, 1930; shot, Rayne, Louisiana, Nov. 5, 1930.
456978, banded June 13, 1930; shot, Coloma, Waushara Co., Wis., July 26, 1930 (about 70 miles north of Madison).
A626621, banded June 13, 1930; shot, Downs, Kansas, Aug. 2, 1930.
A626623, banded June 13, 1930; shot, Branch, Louisiana, Dec. 5, 1930.
A673915, banded June 26, 1930; stepped on in nest by cow, July 2, 1930.
A673917, banded June 26, 1930; shot, Santa Rosa, Texas, Feb. 11, 1931.
A673923, banded June 20, 1931; killed in nest by unknown predator, July 5, 1931.
A673925, banded June 20, 1931; killed in nest by unknown predator, July 5, 1931.
A673928, banded June 20, 1931; shot, Mercer, Missouri, Oct. 2, 1931.
A673931, banded June 20, 1931; found dead, Lowry, Minnesota, Aug. 22, 1931.
A673932, banded June 20, 1931; killed in experiment.
A626617, banded June 30, 1931; killed at nest by mink, July 8, 1931.
A673927, banded June 30, 1931; killed at nest by mink, July 8, 1931.
A695914, banded July 3, 1931; shot, Cassoday, Kansas, Oct. 31, 1931.
A626620, banded July 5, 1931; killed at nest by mink, July 8, 1931.

Omitting the one killed under experiment, we have then approximately thirty-four per cent of the banded birds dead within a period of one year and nine months from the time they began to fly. All but one of them were dead in less than eight months, and six perished a few days after being banded. Those on which we have returns lived on the average only about one hundred and twenty days after being banded. Nine were shot. Considering the offhand way in which most hunters shoot down hawks, without bothering to retrieve them, and the small chance there is for the observation by competent and interested persons on birds that perish in other ways, these returns certainly make it appear probable that very few indeed of the Marsh Hawks hatched in any year live to see their first birthday.

Two other facts in these records are worth calling attention to. First is the fact that two hawks shot before September of the year they were banded were killed a considerable distance *north* of the place of banding. This rather points to an exploration flight before real migration, a habit

not unknown in some other species. Secondly it is worth noting how soon after the power of flight is attained migration southward occurs. The appearance of one of them in Kansas not more than fifty days after first flying is certainly unexpected.—GEORGE WAGNER, University of Wisconsin.

Juvenile Towhees Return to Birthplace —Recent notes in *Bird-Banding* as to whether juveniles return to the place of their birth to breed have prompted the writer to scan returns on Towhees secured during the past eight years on Martha's Vineyard, Massachusetts. Mrs. Gillespie and I have banded sixty-nine Towhees during this period, twenty-one of which were adults and the remaining forty-eight immatures, readily separable from their parents by their streaked sides and flanks. Four adults, or about nineteen and one half per cent, have returned subsequent years. Of the immatures, seven, or about fourteen and one half per cent, have returned subsequent years to the identical spots where banded, being trapped in midsummer, often with young ones, so that no doubt existed as to their being breeding birds.

The seven instances of immature Towhees returning the following year after birth are as follows:

244653—banded during summer of 1925 by Miss Grace C. Meleney, was trapped by us on June 28, 1926, and July 18, 1927.
476687—banded July 17, 1927—returned July 21, 1928.
476696—banded Aug. 1, 1927—returned Aug. 12, 1928, and July 22, 1929.
478671—banded Aug. 3, 1927—returned July 28, 1928.
Found dead by Miss Meleney.
478672—banded Aug. 3, 1927—returned July 30, 1928.
242013—banded Aug. 7, 1928—returned Aug. 24, 1929.
Trapped by Miss Meleney.
A201140—banded Aug. 28, 1929—returned Aug. 21, 1930.
Trapped by Mr. Thomas F. Power.

The trapping stations of Miss Meleney and Mr. Power are in close proximity to our station at Oak Bluffs, Massachusetts, the territories at times overlapping one another.—JOHN A. GILLESPIE, Glenolden, Pennsylvania.

Locating Returned Song Sparrows Banded as Nestlings.—In order to locate the Song Sparrows (*Melospiza melodia beata*) banded in the nest that survive to the beginning of the next nesting season, a great deal of searching has to be done. I cover the whole sixty acres of Interpont repeatedly, making occasional trips one-eighth of a mile to the north and the west and three-fourths of a mile to the south. Some of the young residents are located in the fall, and others in late January or early February during the first spell of warm weather that starts this species into territory activity. The resident males should be discovered and their locations mapped before the summer residents arrive from late February to the first few days of April.

The best time to examine the females is from their arrival in late March to the middle of April. At this time the pair keep together, the female is not yet incubating, and the leaves are not out; after nesting has begun it is a tedious task to wait for the female to leave her nest (unless one wishes to find the latter). The limits of a territory can be found by following the birds; they will go ahead for a certain distance, but double back when they reach their boundary. The male can be distinguished by his tendency to keep behind and above his mate as if guarding her; she stays near the ground, and it is no easy matter to make sure whether or not she carries a band.

After I find a bird banded only on the right leg (as I band all my nestlings; all other Song Sparrows receiving the aluminum band on the left leg), I

choose a place to bait, preferably near one of the singing-posts; it must be easily found by the bird, yet more or less concealed from passers-by. I usually put some sort of old wire on the feeding spot to mark the place and also in hopes that the bird will later enter the trap more readily. I then bait every day or so for a period of a few days to several weeks, using baby-chick feed, rolled oats, cracker, and bread crumbs. Millet, hemp, and canary-seed are the best baits, but are much more expensive. I have sometimes tried these last as special attractions inside the trap, but do not know whether success is any greater with them than without. After I capture a lone male on his territory, I continue baiting, so as to get his mate when she comes.

Winter and early spring are, of course, the best times to trap, but I can catch most of the Song Sparrows on their territories even after nesting has begun. On school days and during school hours I do my trapping in the field with two forms of the government sparrow trap, and occasionally two pull-string traps. Since Song Sparrows eat for a few minutes, then leave and usually return in about twenty minutes, one does not have to watch a drop-trap constantly, but can explore the surroundings during "intermissions". I can sometimes "shoo" a bird into the trap; i.e. if I return and find my subject has not entered, I hunt it up and gently urge it towards the trap. In a number of cases it has followed my suggestion with gratifying dispatch.

Only three males banded as nestlings have been caught in our garden, and none of the females. Eleven resident males have taken up their territories from 120 to 730 yards from their birthplaces, and three summer-resident males from 250 to 300 yards from home. Six females have settled from 155 to 500 yards from the nests in which they hatched.—MARGARET M. NICE, Columbus, Ohio.

Some Live Weights and Measurements of Small Birds.—Early in the fall of 1932 at the Austin Ornithological Research Station an attempt was made to weigh, and in some cases to make wing measurements of, as many small passerine birds as possible. The need for a large series of weights and measurements for each species is self-evident, particularly for use as a possible basis in separating the sexes of adults or young of species that seemingly show no apparent sexual differences.

The volume of migrants passing through the Station grounds became so great, however, that in the process of trapping and banding very little time was available for the exacting and time-absorbing manipulations of scales, dividers, and rule. The following data are given for whatever interest and value they may contain. The majority of these birds were weighed during the forenoon, when full crops might be expected.

Phœbe. *Sayornis phœbe*. Oct. 1, adult, weight 21.1 grams.
Acadian Flycatcher. *Empidonax virescens*. Sept. 1, immature, weight 14.29 grams; wing 72 mm.; tail 52 mm.
Wood Pewee. *Myiochanes virens*. Sept. 2, adult, weight 13.45 grams; wing 84 mm.; tail 65 mm.
Black-capped Chickadee. *Penthestes a. atricapillus*. Sept. 21, adult, weight 10.0 grams; wing 62 mm.; tail 61 mm.
Brown Creeper. *Certhia f. americana*. Sept. 30, adult, weight 6.6 grams.
Brown Creeper. *Certhia f. americana*. Oct. 10, adult, weight 8.3 grams.
Eastern Winter Wren. *Nannus h. hiemalis*. Oct. 2, adult, weight 8.4 grams.
Eastern Mockingbird. *Mimus p. polyglottos*. Sept. 23, immature, weight 53.0 grams; wing 106 mm.; tail 114 mm.
Catbird. *Dumetella carolinensis*. Sept. 2, immature, weight 33.32 grams.
Eastern Hermit Thrush. *Hylocichla g. faxoni*. Sept. 14, adult, weight 26.67 grams.
Gray-cheeked Thrush. *Hylocichla m. aliciæ*. Sept. 27, adult, weight 31.3 grams; wing 103 mm.; tail 70 mm.
Veery. *Hylocichla f. fuscescens*. Sept. 21, immature, weight 25.3 grams; wing 99 mm.; tail 76 mm.

Eastern Bluebird. *Sialia s. sialis.* Sept. 1, immature ♀, weight 29.92 grams.
Eastern Bluebird. *Sialia s. sialis.* Sept. 1, immature ♀, weight 27.65 grams.
Eastern Bluebird. *Sialia s. sialis.* Sept. 1, immature ♀, weight 27.62 grams.
Eastern Bluebird. *Sialia s. sialis.* Sept. 1, adult ♀, weight 28.54 grams.
Eastern Bluebird. *Sialia s. sialis.* Sept. 1, adult ♀, weight 26.94 grams.
Eastern Bluebird. *Sialia s. sialis.* Sept. 1, adult ♀, weight 26.49 grams.
Eastern Bluebird. *Sialia s. sialis.* Sept. 5, immature, weight 29.1 grams.
Eastern Golden-crowned Kinglet. *Regulus s. satrapa.* Oct. 2, adult ♀, weight 7.3 grams.
Eastern Ruby-crowned Kinglet. *Corthylio c. calendula.* Oct. 1, adult ♂, weight 5.8 grams.
Cedar Waxwing. *Bombycilla cedrorum.* Sept. 22, immature, weight 28.4 grams; wing 91 mm.; tail 53 mm.
Red-eyed Vireo. *Vireo olivaceus.* Sept. 14, immature, weight 20.36 grams.
Philadelphia Vireo. *Vireo philadelphicus.* Sept. 13, adult, weight 11.17 grams.
Tennessee Warbler. *Vermivora peregrina.* Oct. 10, immature, weight 8.5 grams.
Myrtle Warbler. *Dendroica coronata.* Sept. 26, adult ♀, weight 11.0 grams.
Black-poll Warbler. *Dendroica striata.* Sept. 21, immature, weight 11.2 grams.
Black-poll Warbler. *Dendroica striata.* Sept. 22, immature, weight 12.0 grams.
Northern Pine Warbler. *Dendroica p. pinus.* Sept. 2, immature, weight 11.0 grams.
Northern Pine Warbler. *Dendroica p. pinus.* Sept. 2, immature, weight 11.5 grams.
Northern Pine Warbler. *Dendroica p. pinus.* Sept. 27, immature, weight 11.3 grams; wing 68 mm.; tail 55 mm.
Northern Pine Warbler. *Dendroica p. pinus.* Sept. 27, adult ♂, weight 11.6 grams; wing 74 mm.; tail 57 mm.
Northern Prairie Warbler. *Dendroica d. discolor.* Sept. 1, immature, weight 6.11 grams.
Western Palm Warbler. *Dendroica p.palmarum.* Sept. 14, immature, weight 10.25 grams.
Western Palm Warbler. *Dendroica p. palmarum.* Sept. 27, adult, weight 9.7 grams; wing 62 mm.; tail 49 mm.
Western Palm Warbler. *Dendroica p. palmarum.* Sept. 27, immature, weight 9.9 grams; wing 62 mm.; tail 50 mm.
Oven-bird. *Seiurus aurocapillus.* Sept. 1, immature, weight 20.11 grams; wing 74 mm.; tail 52 mm.
Northern Water-Thrush. *Seiurus n. noveboracensis.* Sept. 21, adult, weight 15.6 grams; wing 73 mm.; tail 50 mm.
Connecticut Warbler. *Oporornis agilis.* Sept. 13, immature, weight 13.06 grams.
Yellow-breasted Chat. *Icteria v. virens.* Sept. 14, adult ♀, weight 25.64 grams.
Yellow-breasted Chat. *Icteria v. virens.* Sept. 14, adult ♂, weight 31.11 grams.
Hooded Warbler. *Wilsonia citrina.* Sept. 11, adult ♀, weight 10.11 grams.
Canada Warbler. *Wilsonia canadensis.* Sept. 14, immature, weight 10.55 grams.
Eastern Cowbird. *Molothrus a. ater.* Aug. 31, immature ♂, weight 42.9 grams.
Eastern Cowbird. *Molothrus a. ater.* Sept. 22, immature ♀, weight 35.3 grams.
Red-eyed Towhee. *Pipilo e. erythrophthalmus.* Sept. 14, adult ♀, weight 36.97 grams.
Eastern Savannah Sparrow. *Passerculus sandwichensis savanna.* Sept. 20, immature, weight 15.4 grams; wing 65 mm.; tail 46 mm.
Eastern Savannah Sparrow. *Passerculus sandwichensis savanna.* Oct. 1, adult, weight 19.1 gram; wing 69 mm.; tail 50 mm.
Eastern Vesper Sparrow. *Poaecetes g. gramineus.* Aug. 22, adult, weight 24.87 grams.
Eastern Vesper Sparrow. *Poaecetes g. gramineus.* Sept. 18, adult, weight 25.2 grams; wing 77 mm.; tail 60 mm.
Eastern Vesper Sparrow. *Poaecetes g. gramineus.* Sept. 22, adult, weight 26.8 grams; wing 83 mm.; tail 65 mm.
Eastern Vesper Sparrow. *Poaecetes g. gramineus.* Sept. 22, adult, weight 27.3 grams; wing 81 mm.; tail 62 mm.
Eastern Vesper Sparrow. *Poaecetes g. gramineus.* Sept. 22, adult, weight 25.8 grams; wing 84 mm.; tail 63 mm.
Eastern Vesper Sparrow. *Poaecetes g. gramineus.* Sept. 27, adult, weight 25.7 grams; wing 80 mm.; tail 64 mm.
Eastern Tree Sparrow. *Spizella a. arborea.* Nov. 25, adult, weight 17.8 grams; wing 77 mm.; tail 71 mm.
Eastern Tree Sparrow. *Spizella a. arborea.* Nov. 25, adult, weight 17.0 grams; wing 74 mm.; tail 69 mm.
Eastern Chipping Sparrow. *Spizella p. passerina.* Sept. 2, immature, weight 12.09 grams; wing 69 mm.; tail 61 mm.
Eastern Chipping Sparrow. *Spizella p. passerina.* Sept. 5, immature, weight 11.0 grams; wing 68 mm.; tail 57 mm.
Eastern Chipping Sparrow. *Spizella p. passerina.* Sept. 3, immature, weight 11.47 grams; wing 66 mm.; tail 57 mm.
Eastern Chipping Sparrow. *Spizella p. passerina.* Sept. 21, adult, weight 13.2 grams; wing 68 mm.; tail 57 mm.
Eastern Chipping Sparrow. *Spizella p. passerina.* Sept. 22, adult, weight 11.2 grams; wing 67 mm.; tail 56 mm.
Eastern Chipping Sparrow. *Spizella p. passerina.* Sept. 27, adult, weight 13.7 grams; wing 72 mm.; tail 61 mm.
Eastern Chipping Sparrow. *Spizella p. passerina.* Sept. 27, adult, weight 13.1 grams; wing 70 mm.; tail 58 mm.
White-crowned Sparrow. *Zonotrichia l. leucophrys.* Sept. 21, immature, weight 24.4 grams; wing 75 mm.; tail 72 mm.

White-throated Sparrow. *Zonotrichia albicollis*. Sept. 22, adult, weight 22.5 grams; wing 71 mm.; tail 72 mm.
Swamp Sparrow. *Melospiza georgiana*. Sept. 21, adult, weight 15.7 grams; wing 59 mm.; tail 53 mm.

—MAURICE BROUN, Austin Ornithological Research Station, North Eastham, Massachusetts.

Night Migration of Eastern Chipping Sparrows.—A telephone call from a Capitol guard at 9.00 P.M. on the cloudy and windy night of October 23d informed me that our National Capitol building had been suddenly surrounded by small birds. Immediate investigation revealed that fully a thousand Chipping Sparrows were swarming in the lighted area from the statue of Freedom on the apex of the dome, outward over the Senate and House wings and on to the lighted terrace and walks surrounding the building.

The birds were in greatest numbers in the areas of maximum light-concentration. From twenty to fifty birds were resting on, or immediately in front of, each of the eight clusters of high-powered flood lights placed on the roof of the Senate and House wings, illuminating the dome at night.

The birds appeared completely bewildered, scarcely an action being typical of the Chipping Sparrow as it is seen under normal conditions. For a few minutes one would settle down on the walk in the shadow of a step or projection, often almost under foot of pedestrians. Shortly it would fly with uncertainty and with no apparent purpose toward another lighted area. This restless movement was continuous from one area of light-concentration to another, and there were from fifteen to one hundred birds constantly on the wing, flitting aimlessly back and forth over the Senate and House wings or irregularly circling the lighted dome.

Each of the three arcades on the dome appeared to be alive with bewildered birds unable to determine whether it was night or day, whether they should resume their migratory flight or settle down to roost. The steps, walks, and terrace also had their shares of birds, which were so tame that the observer could approach within five or ten feet. On the middle deck of the dome a lone Sparrow Hawk was startled from its perch on the top of one of the columns. It appeared to be in no way molesting the smaller birds that were endlessly passing in front of it. As usual, a number of domestic pigeons were also roosting in the darkened niches of the dome.

The absence of any leadership among the Chipping Sparrows was pronounced; they seemed to be held in the same general area merely by a desire for association with others of their kind and by the concentration of light. When in flight each individual seemed to be a law unto itself; consequently there was no group course. In their erratic zigzagging back and forth a number were seen to penetrate into the darkness, but apparently the attraction of light and companions would immediately draw them back. Even though there was some insect life present, no feeding was noted.

When the flood-lights illuminating the dome were turned off shortly after midnight, there was a marked cessation of activity. A weak illumination still shone on the statue of Freedom capping the dome. Many birds promptly flew to this area and seemed to occupy every available crevice. Most of the remaining individuals that had been on the top of the building flew to the lighted area on the terrace and walks surrounding the main structure. By 1:00 A.M. there was very little activity and the birds seemed to be settled for the night. Consequently the observer left, but when he returned about sunrise not a Chipping Sparrow could be found.

No birds were noted on the nights preceding or succeeding this wave of migration, but a week later, on the night of October 29th, while the writer was out of the city, another huge flock was reported at the Capitol. From

reports their actions were typical of those here described.—Clarence Cottam, United States Biological Survey, Washington, D. C.

Interesting Chickadee Records.—Among interesting Chickadee records at my station this fall there has been one bird at least five years old and another one at least six years old. Their records follow:

A87171	Banded February 17, 1927;	Return-1[1] December 25, 1927
		Return-2 February 2, 1930
		Return-3 March 21, 1931
		Return-4 February 25, 1932
		Return-5 October 11, 1932
A87173	Banded December 19, 1927;	Return-1 March 24, 1931
		Return-2 November 10, 1931
		Return-3 October 31, 1932

The autumn and winter of 1928–29 I was away from home, so have no record of returns for that year. Also I have no record of A87173 in the year 1929–30.

One pair of Chickadees, F23149 and F23154, which, by the use of colored bands, I traced to their nesting area this summer, appeared together at my station on October 5th and again on October 11th. Since the latter date F23154 has not been seen. This pair and their young came to the feeding-shelves together in July, but unfortunately I was unable to capture the young to band them. The last date upon which the two young were seen with F23149 was July 11th, at which time, however, the young fed themselves. On October 11th, when the pair of old birds was last seen together, one or possibly two young Chickadees accompanied them, all four busily feeding and storing up food. Two young Chickadees were given bands F31780 and F31792, with colored bands in addition, on October 23d and 24th, respectively, and on the 29th these two birds were again busily storing food in company with F23149. I would give a good deal to know if these are the young of the above mated pair, or merely others of the younger set to whom they had taken a liking.

Two other Chickadees, F23150 and F23152, I did not succeed in tracing in the spring, but I feel sure that they were mates. Both were banded January 29, 1932, within ten minutes of each other, a third Chickadee having been banded between these two. The three were evidently of one flock, as shown by later sight repeats in each other's company, but from the first the two whose numbers are given above showed particular friendliness toward each other, frequently remaining on the feeding-shelves and eating most amicably together, which they would not do even with the third member of their flock. These two birds were recorded together on October 8th, and again came together on October 25th. Both have repeated since, though on different days so far as I have seen.

From these two instances it seems that attachment between mates may hold them together until fall. It remains to be seen whether itwill hold over, or be resumed, for another breeding season.

Both individuals of a third pair, C50532 and F23148, which I traced to their nest in the spring have returned this fall, although I have not happened to see them together. The Hardwick Chickadees seem to have had a successful season, as seventy per cent of those that I marked with colored bands last winter have already returned.—Dorothy A. Baldwin, Hardwick, Massachusetts, November 17, 1932.

[1] I am reporting these recaptures as "returns" following the practice of the Biological Survey, though I am sure most of the records are merely repeats.

A Red-bellied Woodpecker Six and a Half Years of Age.—On March 20, 1932, a return was obtained on female Red-bellied Woodpecker (*Centurus carolinus*) 427557. This bird was banded as an adult on May 20, 1926, consequently it was at least a year old when banded. The known history of this bird is as follows: banded on May 20, 1926;[1] a return-1 on December 10, 1927; repeated on February 14, March 5, and March 17, 1928; a return-2 on January 27, 1929; repeated February 23, 1929; and a return-3 on March 20, 1932. On the latter date the band was found to be abraded, rendering part of the number almost illegible, so band A220175 was substituted. The above records show the bird to have been at least six and a half years old in 1932. We shall anxiously anticipate the return of this bird during another season.—PAUL A. STEWART, Leetonia, Ohio.

Known History of Eastern Robin 626740.—An Eastern Robin, a male nestling, was given band 626740 on July 18, 1928, at my station in Norristown, Pennsylvania. He was taken as a return-1 on May 14, 1930 and as a return-2 on May 28, 1932. During 1932 he raised a brood within fifty feet of the nest in which he was hatched. His mate this past season was A322102, banded as an adult June 15, 1929, and a return-1 April 14, 1930, a return-2 April 20, 1931, and a return-3 April 23, 1932. It is not known that these birds were mated more than one year, though it should be noted that a male four years old was mated in 1932 to a female also at least four years old. Band 626740 was so badly worn that it was replaced by B329638. The original nest and the one this year were about ten feet up in a wild cherry tree.—RAYMOND J. MIDDLETON, Norristown, Pennsylvania.

A White-throated Sparrow Recovered in Maryland.—A White-throated Sparrow (*Zonotrichia albicollis*) was banded as an adult with B116127 at Elmhurst, Long Island, N. Y., on November 1, 1930. It was not again heard of until recaptured on November 11, 1932, at Silver Spring, Md., by Mr. Harold S. Peters of the Bureau of Entomology, United States Department of Agriculture, Washington, D. C.—MARIE V. BEALS, 5833 85th Street, Elmhurst, Long Island, N. Y.

RECENT LITERATURE

News from the Bird-Banders, Vol. VII, No. 4. Published by the Western Bird-Banding Association, Berkeley, California. In the issue for November, 1932, of this mimeographed quarterly bulletin, appears an excellent article on "Territory,"[2] whose author is unfortunately hidden by anonymity. In the first paragraph of this article tribute is paid to the work of the bird-banders of to-day when the author states that "there are two ways of constructing our picture of the life of the bird—one is a mosaic, an effort to patch together a large number of fragments of observation, of many shades of significance and reliability, the other a direct and continuous drawing,

[1]This record was obtained by Mr. L. B. Strabala, whose station is situated immediately adjacent to mine, the traps at times being, indeed, as close as a few feet. All other records are of my own capture.

[2]This article was written by Mr. T. T. McCabe, President of the Western Bird-Banding Association, who writes me that he started its preparation as "a mere editorial suggestion since our docket was quite empty at the time . . . and ended by carrying it perhaps farther than I should."—EDITOR.

in which the whole picture is at least laid in, with a necessary sense of composition and subordination. Probably the development of the latter method in the last decade has created a firmer and more rational basis for the comprehension of the minds and actions of birds than all the work that went before."

Full credit is given for the work of the British scientist H. Eliot Howard in his studies of the behavior of birds, but while Howard made many interesting and valuable observations, there is little of it that is really new, for similar studies had been made by earlier ornithologists, the results of some of them having been published as long ago as 1820. But Howard crystallized the material and brought it out in clear and understandable form. As our author states, "Howard's achievement is synthesis. . . . The facts of territory indicated separately . . . are fruitless without the final summation and coordination." And he goes on to say, "The behavior of a bird through the period of reproduction . . . must be looked upon as a 'neurally linked' series of stepped-up reactions, progressive, dependent each upon the one which went before, correlated with physiological changes, controlling and timing the stages of the process of reproduction with relation to external factors, and dependent upon stimulation from environment or mate to unlock each response at the most advantageous time and manner, —an organization of almost unlimited complexity and great perfection."

Howard's personal work was based largely upon a long and intensive study of certain species of small land-birds. He did not mark or "ring" his birds, but later Burkitt in his study of the Robin Redbreast in England, and Mrs. Nice with the Song Sparrow in Ohio, used bird-banding as an important aid in their researches. The article briefly summarizes the results of these and other studies of territory. A. H. Miller "is not inclined to emphasize the territorial instinct as primarily bound into reproductive physiology," for the fall is "the time . . . of maximum territory-seeking population," according to his studies of American shrikes. It seems probable that it may be food-supply rather than nesting suitability that governs the choice of territory, in some non-migratory species at least. On the other hand Huxley, writing of the Black-tailed Godwit in Holland, found that the birds may arrive at the breeding area already paired or otherwise, or occupy territory immediately upon arrival or after long delay. Economic necessity may govern the territorial actions of our parasitic Cowbird, according to Friedmann.

Our author concludes that "before such a formula as Howard's can be judged it must be tested by application to the facts of a great number of species. The present array of inadequately studied species is quite insufficient. . . . Howard has treated territory as a phenomenon of the reproductive cycle. Certainly it is allied by every degree of proximity with similar situations which have nothing to do with reproduction. . . . A continuous and well-nigh universal phenomenon takes on a peculiarly vivid economic and psychological significance in birds in the season of reproduction, and derives its origin or essential value from the problems of that season. . . . When a theory has become popular it behooves thinking people to hold back as much as possible and try to discriminate the grain of truth which most theories possess from the bushel of parrot-like repetition and forced application." With this in mind he prepared this paper, "the chief object of which is to induce more work on territorial problems through banding." A bibliography of twenty-four titles completes the paper, which is far too valuable and suggestive not to deserve more publicity than it seems likely to receive. Territorial questions open a field for much intensive study by bird-banders, and we urge all readers of *Bird-Banding* who are interested in this phase of the work to get a copy of the

article here reviewed, to peruse it thoughtfully, and to profit by its suggestions.—J. B. M.[1]

Der Vogelzug, Vol. 3, No. 4, October, 1932.—This number opens with a paper by Geyr von Schweppenburg on the angle of migration with respect to latitude and longitude and suggests the use of more detailed and explicit compass directions in recording observational data locally.

Eisentraut writes of his observations on bird-migration in the little known Columbrete Islands in the Gulf of Valencia, Spain, and lists thirty-three species seen there.

Schildmacher made a trip to Iceland in the spring of 1932 and contributes an account of his bird observations.

Silvia von Spiess presents an abstract of two reports of the members of the ornithological section of the royal Rumanian Gamekeepers Council, which gives some local notes on birds.

Drost and Schüz describe the migration of the Red-throat (*Erithacus r. rubecula*) and present tables and a map showing the dispersal of birds banded at Rossitten and at Helgoland.

Drost writes on the wanderings of German breeding individuals of the Great Titmouse (*Parus m. major*) and the Blue Titmouse (*Parus c. caeruleus*. These wanderings are not real migrations, but local movements, ranging from fifty to six hundred kilometers in extent.

Schuz continues his compilation of recoveries of birds banded in foreign (that is, non-German) stations.

The usual assortment of short notes and an index to the whole volume complete the number.—H. F.

[1] *News from the Bird-Banders* is published by the Western Bird-Banding Association Museum of Vertebrate Zoölogy, Berkeley, California.—Editor.